APPENDIX F

Hydrology and Hydraulic Analysis

HYDROLOGY AND HYDRAULIC ANALYSIS

FOR

Tract 18233
City of Colton
San Bernardino County

PREPARED UNDER THE SUPERVISION OF:

Gary A. Martin, R.C.E. 50318 Exp. ~~6/30/07~~ 6/30/19 Date: 11/30/17

JN 07-0197-01

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1 INTRODUCTION

1.1 Project Description

Tentative Tract Map (TTM) 18233 is a proposed development of a portion of a 240 acre site in south Colton, California. Only the western 49.39 acres of the site are proposed to be part of this Tract 18233. The remainder of the larger site will remain unchanged and remain undeveloped. The approximately 49 acre portion is south of Litton Avenue and east of the ridgeline that is west of and visible from Bostick Street and that currently drains to the east. The 49 acre parcel(s) are proposed to be created by a Lot Line Adjustment (LLA) that will be comprised of 2 lots totaling the 49 acres and cover the full hydrologic tributary area of water that drains over, across, and through the portion of the site being developed. The proposed LLA is an exhibit in this section 1. The proposed TTM is also included as a section to this section 1.

The proposed development is for 86 detached single family homes, a park, and a drainage retention basin. Of the 49.39 acres in the TTM area, 30.61 acres will remain undeveloped and in their natural state and remain as open space. The 49 acre TTM area is bounded on the east by Bostick Street, on the south by Palm Avenue and by undeveloped land, on the west by undeveloped land (which is the rest of the 240 acre site), and on the north by Litton Street.

Litton Avenue along the north edge of the TTM boundary is currently a private street but with this TTM the south side will be dedicated to a public street. (The north side may also be dedicated to a public street as well, that remains to be determined.) The south side of Litton will be fully improved which from a hydraulic perspective means all drainage water will be fully channelized. If property owners on the north side of Litton dedicate the north half to public right of way then the development will also improve the north half of the street from Bostick to Terrace view with curb, gutter, sidewalk, street lights, and paving. These north side improvements would not receive any runoff from area within the TTM boundary. The north side of Litton improvements would channelize the existing runoff water that currently comes from north of the Litton Avenue centerline and now flows over bare earth adjacent to the poorly paved road. The channelization of this north side runoff would improve the area hydraulically and help eliminate erosion, sediment flow, and any flooding potential.

The net result of the TTM development along with all related drainage improvements will be to control and channelize the runoff and provide retention and filtration. Erosion and sediment carry and washout will be greatly improved as a result of this development being built.

1.2(a) Existing Conditions

The site is currently in a natural condition, containing grasses and brush. Topographically, the site is generally hilly, with a steep slope toward the southwest and west. Site topographic relief is on the order of 370 feet. The lowest elevation of approximately 1010 feet above mean sea level (msl) is located in the northeast corner of the site. The highest elevation of approximately 1380 feet msl is located along the southerly property line.

Storm runoff from the vast majority of the 240 acre site will be unaffected by the proposed TTM development. All drainage west of the existing ridgeline along the west side of the TTM will continue to drain to the west and toward the Santa Ana River. Storm runoff from the 49 acre TTM area currently (generally) drains west, across the open fields, to Bostick Street where it then flows either north to Litton or south to Palm. Storm water from the TTM area eventually flows east to La Cadena, then north along La Cadena to the Santa Ana River. The TTM area does receive some runoff from outside the TTM boundary from the parcel to the south.

There is currently an erosion (sediment carry) problem caused by the runoff from the site and the undeveloped nature of the site and land. The majority of the runoff currently comes off the slopes along the west side of the 49 acres and runs across the field area of the site. The steeper slopes are more rocky and less prone to erosion. But, in heavy storms, when the runoff traverses the field it will pickup sediment and erode the soil downstream and out onto Litton and Bostick.

1.2(b) Post Development Conditions

With the development of the tract the primary development area, the "field", will be developed and terraced for house pads. The flow coming off the steeper hills will be captured and channelized in drainage "vee"-ditches and routed away from the field area, not allowing it to erode the field area anymore. Streets and curb and gutter will be constructed in the field area and storm runoff will be channelized that will prevent erosion. The drainage from the field area will be controlled and routed through the tract's retention basin. The retention basin has been sized to handle the calculated flows from all the tributary area, taking into consideration the soils testing determined

percolation rates of the soil in that location. The retention basin will also serve the purposes of controlling the outlet volume of water to the same or less water that in the existing condition, slowing the velocity of the runoff, and cleaning the runoff from the site by allowing the runoff to stop carrying sediment off the site by allowing sediment to settle out of the water in the retention basin.

Additionally, Litton Avenue will be improved (the south side for sure and maybe the north side too depending on if private property landowners provide the City with right of way dedications) with curb and gutter that will channelize the runoff and prevent erosion from these areas. Bostick Street adjacent to the field area will also be fully improved and will channelize runoff.

The net result of all of these storm drainage improvements to the site and surrounding streets will be a greatly improved drainage/erosion/sediment/runoff condition. The volume and rate (in cubic feet per second) of water leaving the site will be the same or lesser than what leaves the site in the current condition, but the storm runoff leaving the site will be controlled and much cleaner, and the sediment will be greatly reduced. All in accordance with drainage law.

Additionally, if the right of way dedications on the north side of Litton Avenue are provided and the north side of Litton gets improved with curb and gutter as well, the runoff situation will be even better as that will channelize that runoff and prevent erosion from these areas.

1.3 Purpose

The purpose of this report is to provide a hydrologic and hydraulic study for Tract 18233 in the City of Colton. The study will calculate the 10-year and 100-year storm discharges to support the processing of the improvement plans.

1.4 Methodology

The used to determine the peak discharges is based upon the criteria contained in the San Bernardino County Hydrology Manual. The hydrologic soil types were determined from the Hydrologic Classification of Soils Map contained in the San Bernardino County Hydrology Manual.

The following work plan and analyses were undertaken in the preparation of this drainage study:

All available information and improvement plans were collected.

The drainage areas within and tributary to the project site were defined.

A hydrologic computer model was prepared based on the proposed drainage patterns.

The results of the study and the calculations for the hydrological analysis are presented in this report.

2 HYDROLOGIC ANALYSIS

2.1 General

The hydrologic studies prepared in this report utilized the rational method in accordance with the San Bernardino County Hydrology Manual.

Hydrology calculations were prepared using the "Rational Method Hydrology Computer Program Package" by CIVILD Engineering Software based on the hydrology manual criterion.

The rational method computes the peak runoff as a function of area, rainfall intensity, and a coefficient of runoff. The basic formula in the rational method is as follows:

$$Q = CIA$$

Where:

Q	=	Peak runoff in cubic feet per second (cfs)
C	=	Coefficient of runoff
I	=	Average rainfall in inches per hour corresponding to the time of concentration
A	=	Drainage area in acres

This formula computes the peak flow rate at all points of concentration. The hydrology analysis is provided in this report.

Land use in the study area is a significant factor in the development of the hydrology study in that the coefficient of runoff used in the rational method are partially dependent upon the type of surface development proposed within the drainage area. The land use used in this study is based upon the development proposed for Tentative Tract 18233.

The major factor affecting infiltration is the nature of the soil. Hydrologic soil types within the study area were determined from the Hydrologic Classification of Soils map contained in the San Bernardino County Hydrology Manual. The soil classification is based on the Soil Conservation Service criteria as follows:

Soil Group A Low runoff potential, consisting mainly of deep, well-defined sands or gravel.

Soil Group B Soils having moderate infiltration rates, consisting of moderately well drained sandy-loam soils with fine to moderate coarse textures.

Soil Group C Soils having slow infiltration rates, consisting of silty-loam soils with moderate fine textures.

Soil Group D High runoff potential with slow infiltration rates, consisting mainly of clay soils with a permanent high water table or shallow soils over impervious material.

Rainfall intensity is expressed in inches of rainfall per hour and is developed by statistical methods from historical rainfall records. The rainfall intensity data used in this study was obtained from the curves for mean precipitation intensities included in the San Bernardino County Hydrology Manual.

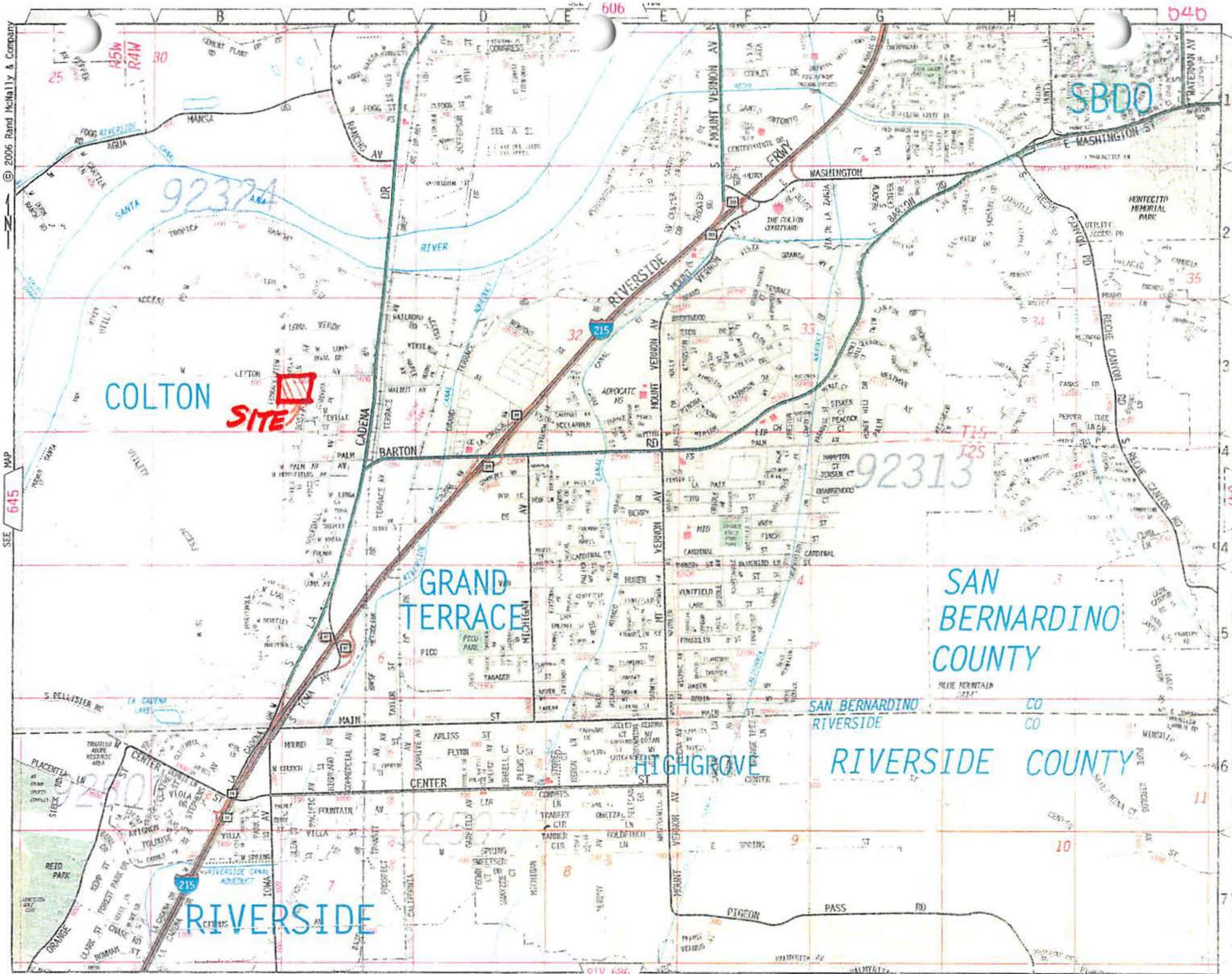
2.2 Rational Method Hydrology Analysis

Upon development of the project site, the site will consist of one drainage area. Refer to the Hydrology Map in Section 5 for developed condition.

The existing drainage area drains to Santa Ana River as sheet flow from the site. The development of the site will continue the drainage pattern to Santa Ana River. The runoff from the site will be conveyed on the surface within the street sections. The runoff will then continue to drain northeasterly and will be intercepted through catch basin located each side of street. Flow then continues through pipe and finally discharges to Santa Ana River.

The hydrology map for the developed and existing condition analysis contains all pertinent information and is presented in Sections 3 and 5 of this report.

2.4 San Bernardino County Hydrology Manual Charts


SAN BERNARDINO
SBDO
COLTON
SITE
GRAND TERRACE
HIGHGROVE
SAN BERNARDINO COUNTY
RIVERSIDE COUNTY
SAN BERNARDINO CO
RIVERSIDE CO
RIVERSIDE
92324
92313
RIVERSIDE FRWY
215
CADENA DR
BARTON RD
MOUNT VERNON AV
WASHINGTON ST
RECHE CANYON RD
MAIN ST
CENTER ST
PIGEON PASS RD
SANTA ANA RIVER
THE COLTON COURTYARD
MONTECITO MEMORIAL PARK
PICO PARK
REID PARK
SEE 606 MAP
SEE 645 MAP
SEE 647 MAP
SEE RIV 686 MAP
646
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3 HYDROLOGY CALCULATIONS

3.1 Existing and Developed 10-Year Hydrology

San Bernardino County Rational Hydrology Program

(Hydrology Manual Date - August 1986)

CIVILCADD/CIVILDESIGN Engineering Software, (c) 1989-2005 Version 7.1
Rational Hydrology Study Date: 09/26/16

Tr 18233
10-Year Rational Hydrology
Existing Condition

Program License Serial Number 6194

********* Hydrology Study Control Information **********

Rational hydrology study storm event year is 10.0
Computed rainfall intensity:
Storm year = 10.00 1 hour rainfall = 0.850 (In.)
Slope used for rainfall intensity curve b = 0.6000
Soil antecedent moisture condition (AMC) = 2

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Process from Point/Station 1.000 to Point/Station 2.000
**** INITIAL AREA EVALUATION ****

UNDEVELOPED (poor cover) subarea
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 1.000
Decimal fraction soil group D = 0.000
SCS curve number for soil(AMC 2) = 86.00
Pervious ratio(Ap) = 1.0000 Max loss rate(Fm)= 0.265(In/Hr)
Initial subarea data:
Initial area flow distance = 922.000(Ft.)
Top (of initial area) elevation = 1382.000(Ft.)
Bottom (of initial area) elevation = 1076.000(Ft.)
Difference in elevation = 306.000(Ft.)
Slope = 0.33189 s(%)= 33.19
TC = k(0.525)*[(length^3)/(elevation change)]^0.2
Initial area time of concentration = 10.043 min.
Rainfall intensity = 2.484(In/Hr) for a 10.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.804
Subarea runoff = 17.776(CFS)
Total initial stream area = 8.900(Ac.)
Pervious area fraction = 1.000
Initial area Fm value = 0.265(In/Hr)

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Process from Point/Station        2.000 to Point/Station        3.000
**** IRREGULAR CHANNEL FLOW TRAVEL TIME ****
------------------------------------------------------------------------------
Estimated mean flow rate at midpoint of channel =     30.463(CFS)
Depth of flow =   1.141(Ft.), Average velocity =  10.381(Ft/s)
      ******* Irregular Channel Data ***********
------------------------------------------------------------------------------
Information entered for subchannel number 1 :
Point number      'X' coordinate     'Y' coordinate
      1              0.00               5.00
      2              2.50               0.00
      3              4.50               0.00
      4              7.00               5.00
Manning's 'N' friction factor =   0.025
------------------------------------------------------------------------------
Sub-Channel flow  =     30.463(CFS)
   '      '    flow top width =      3.141(Ft.)
   '      '     velocity=   10.381(Ft/s)
   '      '    area =      2.934(Sq.Ft)
   '      '    Froude number =     1.893

Upstream point elevation =  1076.000(Ft.)
Downstream point elevation =  1013.000(Ft.)
Flow length =  1150.000(Ft.)
Travel time  =    1.85 min.
Time of concentration =   11.89 min.
Depth of flow =   1.141(Ft.)
Average velocity =  10.381(Ft/s)
Total irregular channel flow =    30.463(CFS)
Irregular channel normal depth above invert elev. =   1.141(Ft.)
Average velocity of channel(s) =  10.381(Ft/s)
 Adding area flow to channel
UNDEVELOPED (poor cover) subarea
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.310
Decimal fraction soil group C = 0.610
Decimal fraction soil group D = 0.080
SCS curve number for soil(AMC 2)  = 83.76
Pervious ratio(Ap) = 1.0000     Max loss rate(Fm)=     0.305(In/Hr)
Rainfall intensity =      2.245(In/Hr) for a    10.0 year storm
Effective runoff coefficient used for area,(total area with modified
rational method)(Q=KCIA) is C = 0.784
Subarea runoff =     25.325(CFS) for   15.600(Ac.)
Total runoff =     43.100(CFS)
Effective area this stream =       24.50(Ac.)
Total Study Area (Main Stream No. 1) =       24.50(Ac.)
Area averaged Fm value =    0.290(In/Hr)
Depth of flow =   1.404(Ft.), Average velocity =  11.363(Ft/s)


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Process from Point/Station        3.000 to Point/Station        4.000
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**** STREET FLOW TRAVEL TIME + SUBAREA FLOW ADDITION ****
-------------------------------------------------------------------------
Top of street segment elevation =  1013.000(Ft.)
End of street segment elevation =  1008.000(Ft.)
Length of street segment  =   465.000(Ft.)
Height of curb above gutter flowline  =    6.0(In.)
Width of half street (curb to crown)  =  18.000(Ft.)
Distance from crown to crossfall grade break  =   8.000(Ft.)
Slope from gutter to grade break (v/hz) =   0.020
Slope from grade break to crown (v/hz)  =   0.020
Street flow is on [1] side(s) of the street
Distance from curb to property line  =   7.000(Ft.)
Slope from curb to property line (v/hz) =   0.020
Gutter width =   2.000(Ft.)
Gutter hike from flowline =  2.000(In.)
 Manning's N in gutter =  0.0150
 Manning's N from gutter to grade break =  0.0150
 Manning's N from grade break to crown =  0.0150
Estimated mean flow rate at midpoint of street =     53.812(CFS)
Depth of flow =   0.770(Ft.), Average velocity =   5.453(Ft/s)
Warning: depth of flow exceeds top of curb
Note:  depth of flow exceeds top of street crown.
Distance that curb overflow reaches into property =   13.50(Ft.)
Streetflow hydraulics at midpoint of street travel:
Halfstreet flow width =  18.000(Ft.)
Flow velocity =   5.45(Ft/s)
Travel time =    1.42 min.     TC =   13.31  min.
 Adding area flow to street
UNDEVELOPED (poor cover) subarea
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.650
Decimal fraction soil group C = 0.350
Decimal fraction soil group D = 0.000
SCS curve number for soil(AMC 2)  = 80.80
Pervious ratio(Ap) = 1.0000     Max loss rate(Fm)=     0.356(In/Hr)
Rainfall intensity =      2.098(In/Hr) for a    10.0 year storm
Effective runoff coefficient used for area,(total area with modified
rational method)(Q=KCIA) is C = 0.764
Subarea runoff =     21.370(CFS) for   15.700(Ac.)
Total runoff =     64.470(CFS)
Effective area this stream =       40.20(Ac.)
Total Study Area (Main Stream No. 1) =       40.20(Ac.)
Area averaged Fm value =    0.316(In/Hr)
Street flow at end of street =     64.470(CFS)
Half street flow at end of street =     64.470(CFS)
Depth of flow =   0.815(Ft.), Average velocity =   5.862(Ft/s)
Warning: depth of flow exceeds top of curb
Note:  depth of flow exceeds top of street crown.
Distance that curb overflow reaches into property =   15.76(Ft.)
Flow width (from curb towards crown)=  18.000(Ft.)

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Process from Point/Station       20.000 to Point/Station       21.000
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**** INITIAL AREA EVALUATION ****
-------------------------------------------------------------------------------
UNDEVELOPED (poor cover) subarea
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.210
Decimal fraction soil group C = 0.790
Decimal fraction soil group D = 0.000
SCS curve number for soil(AMC 2)  = 84.32
Pervious ratio(Ap) = 1.0000     Max loss rate(Fm)=     0.295(In/Hr)
Initial subarea data:
Initial area flow distance =   980.000(Ft.)
Top (of initial area) elevation =  1125.000(Ft.)
Bottom (of initial area) elevation =  1027.000(Ft.)
Difference in elevation =    98.000(Ft.)
Slope =    0.10000  s(%)=      10.00
TC = k(0.525)*[(length^3)/(elevation change)]^0.2
Initial area time of concentration =   13.081 min.
Rainfall intensity =      2.120(In/Hr) for a    10.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.775
Subarea runoff =      4.927(CFS)
Total initial stream area =        3.000(Ac.)
Pervious area fraction = 1.000
Initial area Fm value =    0.295(In/Hr)


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Process from Point/Station       21.000 to Point/Station       22.000
**** STREET FLOW TRAVEL TIME + SUBAREA FLOW ADDITION ****
-------------------------------------------------------------------------------
Top of street segment elevation =  1027.000(Ft.)
End of street segment elevation =  1013.000(Ft.)
Length of street segment  =   220.000(Ft.)
Height of curb above gutter flowline  =    6.0(In.)
Width of half street (curb to crown)  =  17.000(Ft.)
Distance from crown to crossfall grade break  =   7.000(Ft.)
Slope from gutter to grade break (v/hz) =   0.020
Slope from grade break to crown (v/hz)  =   0.020
Street flow is on [1] side(s) of the street
Distance from curb to property line  =   8.000(Ft.)
Slope from curb to property line (v/hz) =   0.020
Gutter width =   2.000(Ft.)
Gutter hike from flowline =  2.000(In.)
 Manning's N in gutter =  0.0150
 Manning's N from gutter to grade break =  0.0150
 Manning's N from grade break to crown =  0.0150
Estimated mean flow rate at midpoint of street =     10.545(CFS)
Depth of flow =   0.373(Ft.), Average velocity =   6.400(Ft/s)
Streetflow hydraulics at midpoint of street travel:
Halfstreet flow width =  12.333(Ft.)
Flow velocity =   6.40(Ft/s)
Travel time =    0.57 min.     TC =   13.65  min.
 Adding area flow to street
UNDEVELOPED (poor cover) subarea
Decimal fraction soil group A = 0.000
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Decimal fraction soil group B = 0.060
Decimal fraction soil group C = 0.940
Decimal fraction soil group D = 0.000
SCS curve number for soil(AMC 2)  = 85.52
Pervious ratio(Ap) = 1.0000     Max loss rate(Fm)=     0.274(In/Hr)
Rainfall intensity =      2.066(In/Hr) for a    10.0 year storm
Effective runoff coefficient used for area,(total area with modified
rational method)(Q=KCIA) is C = 0.778
Subarea runoff =     11.147(CFS) for    7.000(Ac.)
Total runoff =     16.074(CFS)
Effective area this stream =       10.00(Ac.)
Total Study Area (Main Stream No. 1) =       50.20(Ac.)
Area averaged Fm value =    0.280(In/Hr)
Street flow at end of street =     16.074(CFS)
Half street flow at end of street =     16.074(CFS)
Depth of flow =   0.420(Ft.), Average velocity =   7.077(Ft/s)
Flow width (from curb towards crown)=  14.645(Ft.)
End of computations, Total Study Area =           50.20 (Ac.)
The following figures may
be used for a unit hydrograph study of the same area.
Note: These figures do not consider reduced effective area
effects caused by confluences in the rational equation.

Area averaged pervious area fraction(Ap) = 1.000
Area averaged SCS curve number =  83.5
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3.2 Existing and Developed 100-Year Hydrology

San Bernardino County Rational Hydrology Program

(Hydrology Manual Date - August 1986)

CIVILCADD/CIVILDESIGN Engineering Software, (c) 1989-2005 Version 7.1
Rational Hydrology Study Date: 09/26/16

Tr 18233
100-Year Rational Hydrology
Existing Condition

Program License Serial Number 6194

********* Hydrology Study Control Information **********

Rational hydrology study storm event year is 100.0
Computed rainfall intensity:
Storm year = 100.00 1 hour rainfall = 1.200 (In.)
Slope used for rainfall intensity curve b = 0.6000
Soil antecedent moisture condition (AMC) = 3

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Process from Point/Station 1.000 to Point/Station 2.000
**** INITIAL AREA EVALUATION ****

UNDEVELOPED (poor cover) subarea
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 1.000
Decimal fraction soil group D = 0.000
SCS curve number for soil(AMC 2) = 86.00
Adjusted SCS curve number for AMC 3 = 97.20
Pervious ratio(Ap) = 1.0000 Max loss rate(Fm)= 0.055(In/Hr)
Initial subarea data:
Initial area flow distance = 922.000(Ft.)
Top (of initial area) elevation = 1382.000(Ft.)
Bottom (of initial area) elevation = 1076.000(Ft.)
Difference in elevation = 306.000(Ft.)
Slope = 0.33189 s(%)= 33.19
TC = k(0.525)*[(length^3)/(elevation change)]^0.2
Initial area time of concentration = 10.043 min.
Rainfall intensity = 3.507(In/Hr) for a 100.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.886
Subarea runoff = 27.649(CFS)
Total initial stream area = 8.900(Ac.)
Pervious area fraction = 1.000
Initial area Fm value = 0.055(In/Hr)

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Process from Point/Station        2.000 to Point/Station        3.000
**** IRREGULAR CHANNEL FLOW TRAVEL TIME ****
------------------------------------------------------------------------
Estimated mean flow rate at midpoint of channel =      0.000(CFS)
Depth of flow =   1.504(Ft.), Average velocity =  11.704(Ft/s)
      ******* Irregular Channel Data ***********
------------------------------------------------------------------------
Information entered for subchannel number 1 :
Point number      'X' coordinate     'Y' coordinate
      1              0.00               5.00
      2              2.50               0.00
      3              4.50               0.00
      4              7.00               5.00
Manning's 'N' friction factor =   0.025
------------------------------------------------------------------------
Sub-Channel flow  =     48.431(CFS)
   '      '    flow top width =      3.504(Ft.)
   '      '     velocity=   11.704(Ft/s)
   '      '    area =      4.138(Sq.Ft)
   '      '    Froude number =     1.898

Upstream point elevation =  1076.000(Ft.)
Downstream point elevation =  1013.000(Ft.)
Flow length =  1150.000(Ft.)
Travel time  =    1.64 min.
Time of concentration =   11.68 min.
Depth of flow =   1.504(Ft.)
Average velocity =  11.704(Ft/s)
Total irregular channel flow =    48.431(CFS)
Irregular channel normal depth above invert elev. =   1.504(Ft.)
Average velocity of channel(s) =  11.704(Ft/s)
 Adding area flow to channel
UNDEVELOPED (poor cover) subarea
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.310
Decimal fraction soil group C = 0.610
Decimal fraction soil group D = 0.080
SCS curve number for soil(AMC 2)  = 83.76
Adjusted SCS curve number for AMC 3 = 96.26
Pervious ratio(Ap) = 1.0000     Max loss rate(Fm)=     0.074(In/Hr)
Rainfall intensity =      3.203(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for area,(total area with modified
rational method)(Q=KCIA) is C = 0.881
Subarea runoff =     41.504(CFS) for   15.600(Ac.)
Total runoff =     69.153(CFS)
Effective area this stream =       24.50(Ac.)
Total Study Area (Main Stream No. 1) =       24.50(Ac.)
Area averaged Fm value =    0.067(In/Hr)
Depth of flow =   1.849(Ft.), Average velocity =  12.790(Ft/s)
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Process from Point/Station        3.000 to Point/Station        4.000
**** STREET FLOW TRAVEL TIME + SUBAREA FLOW ADDITION ****
------------------------------------------------------------------------
Top of street segment elevation =  1013.000(Ft.)
End of street segment elevation =  1008.000(Ft.)
Length of street segment  =   465.000(Ft.)
Height of curb above gutter flowline  =    6.0(In.)
Width of half street (curb to crown)  =  18.000(Ft.)
Distance from crown to crossfall grade break  =   8.000(Ft.)
Slope from gutter to grade break (v/hz) =   0.020
Slope from grade break to crown (v/hz)  =   0.020
Street flow is on [1] side(s) of the street
Distance from curb to property line  =   7.000(Ft.)
Slope from curb to property line (v/hz) =   0.020
Gutter width =   2.000(Ft.)
Gutter hike from flowline =  2.000(In.)
 Manning's N in gutter =  0.0150
 Manning's N from gutter to grade break =  0.0150
 Manning's N from grade break to crown =  0.0150
Estimated mean flow rate at midpoint of street =     87.829(CFS)
Depth of flow =   0.905(Ft.), Average velocity =   6.634(Ft/s)
Warning: depth of flow exceeds top of curb
Note:  depth of flow exceeds top of street crown.
Distance that curb overflow reaches into property =   20.25(Ft.)
Streetflow hydraulics at midpoint of street travel:
Halfstreet flow width =  18.000(Ft.)
Flow velocity =   6.63(Ft/s)
Travel time =    1.17 min.     TC =   12.85  min.
 Adding area flow to street
UNDEVELOPED (poor cover) subarea
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.650
Decimal fraction soil group C = 0.350
Decimal fraction soil group D = 0.000
SCS curve number for soil(AMC 2)  = 80.80
Adjusted SCS curve number for AMC 3 = 94.48
Pervious ratio(Ap) = 1.0000     Max loss rate(Fm)=     0.108(In/Hr)
Rainfall intensity =      3.025(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for area,(total area with modified
rational method)(Q=KCIA) is C = 0.875
Subarea runoff =     37.293(CFS) for   15.700(Ac.)
Total runoff =    106.446(CFS)
Effective area this stream =       40.20(Ac.)
Total Study Area (Main Stream No. 1) =       40.20(Ac.)
Area averaged Fm value =    0.083(In/Hr)
Street flow at end of street =    106.446(CFS)
Half street flow at end of street =    106.446(CFS)
Depth of flow =   0.970(Ft.), Average velocity =   7.164(Ft/s)
Warning: depth of flow exceeds top of curb
Note:  depth of flow exceeds top of street crown.
Distance that curb overflow reaches into property =   23.48(Ft.)
Flow width (from curb towards crown)=  18.000(Ft.)
```

```
++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       20.000 to Point/Station       21.000
**** INITIAL AREA EVALUATION ****

------------------------------------------------------------------------------
UNDEVELOPED (poor cover) subarea
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.210
Decimal fraction soil group C = 0.790
Decimal fraction soil group D = 0.000
SCS curve number for soil(AMC 2)  = 84.32
Adjusted SCS curve number for AMC 3 = 96.59
Pervious ratio(Ap) = 1.0000     Max loss rate(Fm)=     0.067(In/Hr)
Initial subarea data:
Initial area flow distance =   980.000(Ft.)
Top (of initial area) elevation =  1125.000(Ft.)
Bottom (of initial area) elevation =  1027.000(Ft.)
Difference in elevation =    98.000(Ft.)
Slope =    0.10000  s(%)=      10.00
TC = k(0.525)*[(length^3)/(elevation change)]^0.2
Initial area time of concentration =   13.081 min.
Rainfall intensity =      2.993(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.880
Subarea runoff =      7.899(CFS)
Total initial stream area =        3.000(Ac.)
Pervious area fraction = 1.000
Initial area Fm value =    0.067(In/Hr)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       21.000 to Point/Station       22.000
**** STREET FLOW TRAVEL TIME + SUBAREA FLOW ADDITION ****

------------------------------------------------------------------------------
Top of street segment elevation =  1027.000(Ft.)
End of street segment elevation =  1013.000(Ft.)
Length of street segment  =   220.000(Ft.)
Height of curb above gutter flowline  =    6.0(In.)
Width of half street (curb to crown)  =  17.000(Ft.)
Distance from crown to crossfall grade break  =   7.000(Ft.)
Slope from gutter to grade break (v/hz) =   0.020
Slope from grade break to crown (v/hz)  =   0.020
Street flow is on [1] side(s) of the street
Distance from curb to property line  =   8.000(Ft.)
Slope from curb to property line (v/hz) =   0.020
Gutter width =   2.000(Ft.)
Gutter hike from flowline =  2.000(In.)
 Manning's N in gutter =  0.0150
 Manning's N from gutter to grade break =  0.0150
 Manning's N from grade break to crown =  0.0150
Estimated mean flow rate at midpoint of street =     16.874(CFS)
Depth of flow =   0.425(Ft.), Average velocity =   7.160(Ft/s)
Streetflow hydraulics at midpoint of street travel:
Halfstreet flow width =  14.933(Ft.)
Flow velocity =   7.16(Ft/s)
```

```
Travel time =    0.51 min.     TC =   13.59  min.
 Adding area flow to street
UNDEVELOPED (poor cover) subarea
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.060
Decimal fraction soil group C = 0.940
Decimal fraction soil group D = 0.000
SCS curve number for soil(AMC 2)  = 85.52
Adjusted SCS curve number for AMC 3 = 97.10
Pervious ratio(Ap) = 1.0000     Max loss rate(Fm)=     0.057(In/Hr)
Rainfall intensity =      2.925(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for area,(total area with modified
rational method)(Q=KCIA) is C = 0.881
Subarea runoff =     17.880(CFS) for    7.000(Ac.)
Total runoff =     25.780(CFS)
Effective area this stream =       10.00(Ac.)
Total Study Area (Main Stream No. 1) =       50.20(Ac.)
Area averaged Fm value =    0.060(In/Hr)
Street flow at end of street =     25.780(CFS)
Half street flow at end of street =     25.780(CFS)
Depth of flow =   0.477(Ft.), Average velocity =   8.055(Ft/s)
Note:  depth of flow exceeds top of street crown.
Flow width (from curb towards crown)=  17.000(Ft.)
End of computations, Total Study Area =           50.20 (Ac.)
The following figures may
be used for a unit hydrograph study of the same area.
Note: These figures do not consider reduced effective area
effects caused by confluences in the rational equation.

Area averaged pervious area fraction(Ap) = 1.000
Area averaged SCS curve number =  83.5
```

3.3 Proposed and Developed 10-Year Hydrology

San Bernardino County Rational Hydrology Program

(Hydrology Manual Date - August 1986)

CIVILCADD/CIVILDESIGN Engineering Software, (c) 1989-2005 Version 7.1
Rational Hydrology Study Date: 09/26/16

Tr 18233
10-Year Hydrology Study
Developed Condition Are "A"

Program License Serial Number 6194

********* Hydrology Study Control Information **********

Rational hydrology study storm event year is 10.0
Computed rainfall intensity:
Storm year = 10.00 1 hour rainfall = 0.850 (In.)
Slope used for rainfall intensity curve b = 0.6000
Soil antecedent moisture condition (AMC) = 2

++
Process from Point/Station 1.000 to Point/Station 6.000
**** INITIAL AREA EVALUATION ****

RESIDENTIAL(5 - 7 dwl/acre)
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 1.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.000
SCS curve number for soil(AMC 2) = 56.00
Pervious ratio(Ap) = 0.5000 Max loss rate(Fm)= 0.367(In/Hr)
Initial subarea data:
Initial area flow distance = 805.000(Ft.)
Top (of initial area) elevation = 65.800(Ft.)
Bottom (of initial area) elevation = 15.000(Ft.)
Difference in elevation = 50.800(Ft.)
Slope = 0.06311 s(%)= 6.31
TC = k(0.389)*[(length^3)/(elevation change)]^0.2
Initial area time of concentration = 9.823 min.
Rainfall intensity = 2.517(In/Hr) for a 10.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.769
Subarea runoff = 2.322(CFS)
Total initial stream area = 1.200(Ac.)
Pervious area fraction = 0.500
Initial area Fm value = 0.367(In/Hr)

```
++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station        6.000 to Point/Station        6.000
**** CONFLUENCE OF MINOR STREAMS ****
------------------------------------------------------------------------------
Along Main Stream number: 1 in normal stream number 1
Stream flow area =      1.200(Ac.)
Runoff from this stream =      2.322(CFS)
Time of concentration =    9.82 min.
Rainfall intensity =     2.517(In/Hr)
Area averaged loss rate (Fm) =    0.3670(In/Hr)
Area averaged Pervious ratio (Ap) = 0.5000


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station        2.000 to Point/Station        6.000
**** INITIAL AREA EVALUATION ****
------------------------------------------------------------------------------
RESIDENTIAL(5 - 7 dwl/acre)
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 1.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.000
SCS curve number for soil(AMC 2)  = 56.00
Pervious ratio(Ap) = 0.5000     Max loss rate(Fm)=     0.367(In/Hr)
Initial subarea data:
Initial area flow distance =   900.000(Ft.)
Top (of initial area) elevation =    66.700(Ft.)
Bottom (of initial area) elevation =    15.000(Ft.)
Difference in elevation =    51.700(Ft.)
Slope =    0.05744  s(%)=       5.74
TC = k(0.389)*[(length^3)/(elevation change)]^0.2
Initial area time of concentration =   10.466 min.
Rainfall intensity =      2.423(In/Hr) for a    10.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.764
Subarea runoff =      4.072(CFS)
Total initial stream area =        2.200(Ac.)
Pervious area fraction = 0.500
Initial area Fm value =    0.367(In/Hr)


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Process from Point/Station        6.000 to Point/Station        6.000
**** CONFLUENCE OF MINOR STREAMS ****
------------------------------------------------------------------------------
Along Main Stream number: 1 in normal stream number 2
Stream flow area =      2.200(Ac.)
Runoff from this stream =      4.072(CFS)
Time of concentration =   10.47 min.
Rainfall intensity =     2.423(In/Hr)
Area averaged loss rate (Fm) =    0.3670(In/Hr)
Area averaged Pervious ratio (Ap) = 0.5000
```

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++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station        3.000 to Point/Station        6.000
**** INITIAL AREA EVALUATION ****

-------------------------------------------------------------------------------
RESIDENTIAL(5 - 7 dwl/acre)
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 1.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.000
SCS curve number for soil(AMC 2)  = 56.00
Pervious ratio(Ap) = 0.5000     Max loss rate(Fm)=     0.367(In/Hr)
Initial subarea data:
Initial area flow distance =   615.000(Ft.)
Top (of initial area) elevation =    57.000(Ft.)
Bottom (of initial area) elevation =    15.000(Ft.)
Difference in elevation =    42.000(Ft.)
Slope =    0.06829  s(%)=       6.83
TC = k(0.389)*[(length^3)/(elevation change)]^0.2
Initial area time of concentration =    8.682 min.
Rainfall intensity =      2.711(In/Hr) for a    10.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.778
Subarea runoff =      3.164(CFS)
Total initial stream area =        1.500(Ac.)
Pervious area fraction = 0.500
Initial area Fm value =    0.367(In/Hr)


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Process from Point/Station        6.000 to Point/Station        6.000
**** CONFLUENCE OF MINOR STREAMS ****

-------------------------------------------------------------------------------
Along Main Stream number: 1 in normal stream number 3
Stream flow area =      1.500(Ac.)
Runoff from this stream =      3.164(CFS)
Time of concentration =    8.68 min.
Rainfall intensity =     2.711(In/Hr)
Area averaged loss rate (Fm) =    0.3670(In/Hr)
Area averaged Pervious ratio (Ap) = 0.5000


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station        4.000 to Point/Station        5.000
**** INITIAL AREA EVALUATION ****

-------------------------------------------------------------------------------
RESIDENTIAL(5 - 7 dwl/acre)
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.610
Decimal fraction soil group C = 0.390
Decimal fraction soil group D = 0.000
SCS curve number for soil(AMC 2)  = 61.07
Pervious ratio(Ap) = 0.5000     Max loss rate(Fm)=     0.332(In/Hr)
Initial subarea data:
Initial area flow distance =   960.000(Ft.)
Top (of initial area) elevation =    73.000(Ft.)
```

```
Bottom (of initial area) elevation =    21.000(Ft.)
Difference in elevation =    52.000(Ft.)
Slope =    0.05417  s(%)=       5.42
TC = k(0.389)*[(length^3)/(elevation change)]^0.2
Initial area time of concentration =   10.867 min.
Rainfall intensity =      2.369(In/Hr) for a    10.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.774
Subarea runoff =      4.217(CFS)
Total initial stream area =        2.300(Ac.)
Pervious area fraction = 0.500
Initial area Fm value =    0.332(In/Hr)


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Process from Point/Station        5.000 to Point/Station        6.000
**** STREET FLOW TRAVEL TIME + SUBAREA FLOW ADDITION ****
------------------------------------------------------------------------------
Top of street segment elevation =    21.000(Ft.)
End of street segment elevation =    15.000(Ft.)
Length of street segment  =   180.000(Ft.)
Height of curb above gutter flowline  =    6.0(In.)
Width of half street (curb to crown)  =  18.000(Ft.)
Distance from crown to crossfall grade break  =  10.000(Ft.)
Slope from gutter to grade break (v/hz) =   0.020
Slope from grade break to crown (v/hz)  =   0.020
Street flow is on [1] side(s) of the street
Distance from curb to property line  =   7.000(Ft.)
Slope from curb to property line (v/hz) =   0.020
Gutter width =   2.000(Ft.)
Gutter hike from flowline =  2.000(In.)
 Manning's N in gutter =  0.0150
 Manning's N from gutter to grade break =  0.0150
 Manning's N from grade break to crown =  0.0150
Estimated mean flow rate at midpoint of street =      4.496(CFS)
Depth of flow =   0.324(Ft.), Average velocity =   4.096(Ft/s)
Streetflow hydraulics at midpoint of street travel:
Halfstreet flow width =   9.854(Ft.)
Flow velocity =   4.10(Ft/s)
Travel time =    0.73 min.     TC =   11.60  min.
 Adding area flow to street
RESIDENTIAL(5 - 7 dwl/acre)
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 1.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.000
SCS curve number for soil(AMC 2)  = 56.00
Pervious ratio(Ap) = 0.5000     Max loss rate(Fm)=     0.367(In/Hr)
Rainfall intensity =      2.278(In/Hr) for a    10.0 year storm
Effective runoff coefficient used for area,(total area with modified
rational method)(Q=KCIA) is C = 0.767
Subarea runoff =      0.500(CFS) for    0.400(Ac.)
Total runoff =      4.717(CFS)
Effective area this stream =        2.70(Ac.)
Total Study Area (Main Stream No. 1) =        7.60(Ac.)
```

```
Area averaged Fm value =    0.338(In/Hr)
Street flow at end of street =      4.717(CFS)
Half street flow at end of street =      4.717(CFS)
Depth of flow =   0.328(Ft.), Average velocity =   4.141(Ft/s)
Flow width (from curb towards crown)=  10.062(Ft.)


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Process from Point/Station        6.000 to Point/Station        6.000
**** CONFLUENCE OF MINOR STREAMS ****
------------------------------------------------------------------------------
Along Main Stream number: 1 in normal stream number 4
Stream flow area =      2.700(Ac.)
Runoff from this stream =      4.717(CFS)
Time of concentration =   11.60 min.
Rainfall intensity =     2.278(In/Hr)
Area averaged loss rate (Fm) =    0.3375(In/Hr)
Area averaged Pervious ratio (Ap) = 0.5000
Summary of stream data:

Stream Flow rate    Area     TC      Fm       Rainfall Intensity
 No.     (CFS)    (Ac.)       (min)  (In/Hr)      (In/Hr)


1       2.32      1.200       9.82    0.367       2.517
2       4.07      2.200      10.47    0.367       2.423
3       3.16      1.500       8.68    0.367       2.711
4       4.72      2.700      11.60    0.338       2.278
Qmax(1) =
          1.000 *    1.000 *     2.322) +
          1.046 *    0.939 *     4.072) +
          0.917 *    1.000 *     3.164) +
          1.123 *    0.847 *     4.717) + =      13.708
Qmax(2) =
          0.956 *    1.000 *     2.322) +
          1.000 *    1.000 *     4.072) +
          0.877 *    1.000 *     3.164) +
          1.075 *    0.902 *     4.717) + =      13.643
Qmax(3) =
          1.090 *    0.884 *     2.322) +
          1.140 *    0.830 *     4.072) +
          1.000 *    1.000 *     3.164) +
          1.223 *    0.748 *     4.717) + =      13.569
Qmax(4) =
          0.889 *    1.000 *     2.322) +
          0.930 *    1.000 *     4.072) +
          0.815 *    1.000 *     3.164) +
          1.000 *    1.000 *     4.717) + =      13.146

Total of 4 streams to confluence:
Flow rates before confluence point:
       2.322       4.072       3.164       4.717
Maximum flow rates at confluence using above data:
       13.708       13.643       13.569       13.146
```

```
Area of streams before confluence:
        1.200        2.200        1.500        2.700
Effective area values after confluence:
        7.051        7.336        6.406        7.600
Results of confluence:
Total flow rate =     13.708(CFS)
Time of concentration =     9.823 min.
Effective stream area after confluence =      7.051(Ac.)
Study area average Pervious fraction(Ap) =  0.500
Study area average soil loss rate(Fm) =    0.357(In/Hr)
Study area total (this main stream) =       7.60(Ac.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station        6.000 to Point/Station        9.000
**** STREET FLOW TRAVEL TIME + SUBAREA FLOW ADDITION ****
------------------------------------------------------------------------------
Top of street segment elevation =    15.000(Ft.)
End of street segment elevation =    13.200(Ft.)
Length of street segment  =   160.000(Ft.)
Height of curb above gutter flowline  =    6.0(In.)
Width of half street (curb to crown)  =  18.000(Ft.)
Distance from crown to crossfall grade break  =  10.000(Ft.)
Slope from gutter to grade break (v/hz) =   0.020
Slope from grade break to crown (v/hz)  =   0.020
Street flow is on [2] side(s) of the street
Distance from curb to property line  =   7.000(Ft.)
Slope from curb to property line (v/hz) =   0.020
Gutter width =   2.000(Ft.)
Gutter hike from flowline =  2.000(In.)
 Manning's N in gutter =  0.0150
 Manning's N from gutter to grade break =  0.0150
 Manning's N from grade break to crown =  0.0150
Estimated mean flow rate at midpoint of street =     13.815(CFS)
Depth of flow =   0.422(Ft.), Average velocity =   2.991(Ft/s)
Streetflow hydraulics at midpoint of street travel:
Halfstreet flow width =  14.774(Ft.)
Flow velocity =   2.99(Ft/s)
Travel time =    0.89 min.     TC =   10.71  min.
 Adding area flow to street
RESIDENTIAL(5 - 7 dwl/acre)
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 1.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.000
SCS curve number for soil(AMC 2)  = 56.00
Pervious ratio(Ap) = 0.5000     Max loss rate(Fm)=     0.367(In/Hr)
Rainfall intensity =      2.390(In/Hr) for a    10.0 year storm
Effective runoff coefficient used for area,(total area with modified
rational method)(Q=KCIA) is C = 0.765
Subarea runoff =      0.105(CFS) for    0.500(Ac.)
Total runoff =     13.812(CFS)
Effective area this stream =        7.55(Ac.)
Total Study Area (Main Stream No. 1) =        8.10(Ac.)
```

```
Area averaged Fm value =    0.357(In/Hr)
Street flow at end of street =     13.812(CFS)
Half street flow at end of street =      6.906(CFS)
Depth of flow =   0.422(Ft.), Average velocity =   2.991(Ft/s)
Flow width (from curb towards crown)=  14.773(Ft.)


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Process from Point/Station        9.000 to Point/Station        9.000
**** CONFLUENCE OF MINOR STREAMS ****
------------------------------------------------------------------------
Along Main Stream number: 1 in normal stream number 1
Stream flow area =      7.551(Ac.)
Runoff from this stream =     13.812(CFS)
Time of concentration =   10.71 min.
Rainfall intensity =     2.390(In/Hr)
Area averaged loss rate (Fm) =    0.3572(In/Hr)
Area averaged Pervious ratio (Ap) = 0.5000


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Process from Point/Station        7.000 to Point/Station        8.000
**** INITIAL AREA EVALUATION ****
------------------------------------------------------------------------
RESIDENTIAL(5 - 7 dwl/acre)
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.890
Decimal fraction soil group C = 0.110
Decimal fraction soil group D = 0.000
SCS curve number for soil(AMC 2)  = 57.43
Pervious ratio(Ap) = 0.5000     Max loss rate(Fm)=     0.357(In/Hr)
Initial subarea data:
Initial area flow distance =   810.000(Ft.)
Top (of initial area) elevation =    72.400(Ft.)
Bottom (of initial area) elevation =    57.000(Ft.)
Difference in elevation =    15.400(Ft.)
Slope =    0.01901  s(%)=       1.90
TC = k(0.389)*[(length^3)/(elevation change)]^0.2
Initial area time of concentration =   12.518 min.
Rainfall intensity =      2.177(In/Hr) for a    10.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.752
Subarea runoff =      3.929(CFS)
Total initial stream area =        2.400(Ac.)
Pervious area fraction = 0.500
Initial area Fm value =    0.357(In/Hr)


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Process from Point/Station        8.000 to Point/Station        9.000
**** STREET FLOW TRAVEL TIME + SUBAREA FLOW ADDITION ****
------------------------------------------------------------------------
Top of street segment elevation =    57.000(Ft.)
End of street segment elevation =    13.200(Ft.)
Length of street segment  =   810.000(Ft.)
```

```
Height of curb above gutter flowline  =    6.0(In.)
Width of half street (curb to crown)  =  18.000(Ft.)
Distance from crown to crossfall grade break  =  10.000(Ft.)
Slope from gutter to grade break (v/hz) =   0.020
Slope from grade break to crown (v/hz)  =   0.020
Street flow is on [2] side(s) of the street
Distance from curb to property line  =   7.000(Ft.)
Slope from curb to property line (v/hz) =   0.020
Gutter width =   2.000(Ft.)
Gutter hike from flowline =  2.000(In.)
 Manning's N in gutter =  0.0150
 Manning's N from gutter to grade break =  0.0150
 Manning's N from grade break to crown =  0.0150
Estimated mean flow rate at midpoint of street =      6.998(CFS)
Depth of flow =   0.284(Ft.), Average velocity =   4.678(Ft/s)
Streetflow hydraulics at midpoint of street travel:
Halfstreet flow width =   7.883(Ft.)
Flow velocity =   4.68(Ft/s)
Travel time =    2.89 min.     TC =   15.40  min.
 Adding area flow to street
RESIDENTIAL(5 - 7 dwl/acre)
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 1.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.000
SCS curve number for soil(AMC 2)  = 56.00
Pervious ratio(Ap) = 0.5000     Max loss rate(Fm)=     0.367(In/Hr)
Rainfall intensity =      1.922(In/Hr) for a    10.0 year storm
Effective runoff coefficient used for area,(total area with modified
rational method)(Q=KCIA) is C = 0.730
Subarea runoff =      6.027(CFS) for    4.700(Ac.)
Total runoff =      9.957(CFS)
Effective area this stream =        7.10(Ac.)
Total Study Area (Main Stream No. 1) =       15.20(Ac.)
Area averaged Fm value =    0.364(In/Hr)
Street flow at end of street =      9.957(CFS)
Half street flow at end of street =      4.978(CFS)
Depth of flow =   0.312(Ft.), Average velocity =   5.054(Ft/s)
Flow width (from curb towards crown)=   9.264(Ft.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station        9.000 to Point/Station        9.000
**** CONFLUENCE OF MINOR STREAMS ****
------------------------------------------------------------------------
Along Main Stream number: 1 in normal stream number 2
Stream flow area =      7.100(Ac.)
Runoff from this stream =      9.957(CFS)
Time of concentration =   15.40 min.
Rainfall intensity =     1.922(In/Hr)
Area averaged loss rate (Fm) =    0.3638(In/Hr)
Area averaged Pervious ratio (Ap) = 0.5000
Summary of stream data:
```

```
Stream Flow rate    Area     TC      Fm       Rainfall Intensity
 No.     (CFS)    (Ac.)      (min)  (In/Hr)     (In/Hr)


1      13.81      7.551      10.71     0.357      2.390
2       9.96      7.100      15.40     0.364      1.922
Qmax(1) =
          1.000 *     1.000 *     13.812) +
          1.300 *     0.696 *      9.957) + =      22.817
Qmax(2) =
          0.770 *     1.000 *     13.812) +
          1.000 *     1.000 *      9.957) + =      20.591

Total of 2 streams to confluence:
Flow rates before confluence point:
      13.812       9.957
Maximum flow rates at confluence using above data:
       22.817       20.591
Area of streams before confluence:
        7.551        7.100
Effective area values after confluence:
       12.490       14.651
Results of confluence:
Total flow rate =      22.817(CFS)
Time of concentration =     10.715 min.
Effective stream area after confluence =      12.490(Ac.)
Study area average Pervious fraction(Ap) =  0.500
Study area average soil loss rate(Fm) =    0.360(In/Hr)
Study area total (this main stream) =      14.65(Ac.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station        9.000 to Point/Station       10.000
**** PIPEFLOW TRAVEL TIME (Program estimated size) ****
------------------------------------------------------------------------------
Upstream point/station elevation =  1013.200(Ft.)
Downstream point/station elevation =  1005.000(Ft.)
Pipe length  =   110.00(Ft.)   Manning's N = 0.013
No. of pipes = 1  Required pipe flow  =    22.817(CFS)
Nearest computed pipe diameter  =     18.00(In.)
Calculated individual pipe flow  =    22.817(CFS)
Normal flow depth in pipe =   12.13(In.)
Flow top width inside pipe =   16.88(In.)
Critical depth could not be calculated.
Pipe flow velocity =     18.01(Ft/s)
Travel time through pipe =    0.10 min.
Time of concentration (TC) =    10.82 min.


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       10.000 to Point/Station       10.000
**** SUBAREA FLOW ADDITION ****
------------------------------------------------------------------------------
UNDEVELOPED (poor cover) subarea
```

```
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 1.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.000
SCS curve number for soil(AMC 2)  = 78.00
Pervious ratio(Ap) = 1.0000     Max loss rate(Fm)=     0.404(In/Hr)
Time of concentration =    10.82 min.
Rainfall intensity =      2.376(In/Hr) for a    10.0 year storm
Effective runoff coefficient used for area,(total area with modified
rational method)(Q=KCIA) is C = 0.763
Subarea runoff =      0.729(CFS) for    0.500(Ac.)
Total runoff =     23.546(CFS)
Effective area this stream =       12.99(Ac.)
Total Study Area (Main Stream No. 1) =       15.70(Ac.)
Area averaged Fm value =    0.362(In/Hr)


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Process from Point/Station       10.000 to Point/Station       10.000
**** CONFLUENCE OF MINOR STREAMS ****
------------------------------------------------------------------------
Along Main Stream number: 1 in normal stream number 1
Stream flow area =     12.990(Ac.)
Runoff from this stream =     23.546(CFS)
Time of concentration =   10.82 min.
Rainfall intensity =     2.376(In/Hr)
Area averaged loss rate (Fm) =    0.3620(In/Hr)
Area averaged Pervious ratio (Ap) = 0.5192


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Process from Point/Station       20.000 to Point/Station       21.000
**** INITIAL AREA EVALUATION ****
------------------------------------------------------------------------
UNDEVELOPED (poor cover) subarea
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 1.000
Decimal fraction soil group D = 0.000
SCS curve number for soil(AMC 2)  = 86.00
Pervious ratio(Ap) = 1.0000     Max loss rate(Fm)=     0.265(In/Hr)
Initial subarea data:
Initial area flow distance =  1000.000(Ft.)
Top (of initial area) elevation =  1382.000(Ft.)
Bottom (of initial area) elevation =  1072.400(Ft.)
Difference in elevation =   309.600(Ft.)
Slope =    0.30960  s(%)=      30.96
TC = k(0.525)*[(length^3)/(elevation change)]^0.2
Initial area time of concentration =   10.520 min.
Rainfall intensity =      2.416(In/Hr) for a    10.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.801
Subarea runoff =     18.391(CFS)
Total initial stream area =        9.500(Ac.)
Pervious area fraction = 1.000
```

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Initial area Fm value =    0.265(In/Hr)


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Process from Point/Station       21.000 to Point/Station       22.000
**** IMPROVED CHANNEL TRAVEL TIME ****
------------------------------------------------------------------------
Upstream point elevation =  1073.200(Ft.)
Downstream point elevation =  1021.000(Ft.)
Channel length thru subarea  =   895.000(Ft.)
Channel base width     =    2.000(Ft.)
Slope or 'Z' of left channel bank =   1.000
Slope or 'Z' of right channel bank =   1.000
Estimated mean flow rate at midpoint of channel =     20.885(CFS)
Manning's 'N'    = 0.015
Maximum depth of channel  =    3.000(Ft.)
Flow(q) thru subarea =     20.885(CFS)
Depth of flow =   0.598(Ft.), Average velocity =  13.438(Ft/s)
Channel flow top width =    3.196(Ft.)
Flow Velocity =   13.44(Ft/s)
Travel time  =    1.11 min.
Time of concentration =   11.63 min.
Critical depth =      1.219(Ft.)
 Adding area flow to channel
UNDEVELOPED (poor cover) subarea
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.020
Decimal fraction soil group C = 0.980
Decimal fraction soil group D = 0.000
SCS curve number for soil(AMC 2)  = 85.84
Pervious ratio(Ap) = 1.0000     Max loss rate(Fm)=     0.268(In/Hr)
Rainfall intensity =      2.275(In/Hr) for a    10.0 year storm
Effective runoff coefficient used for area,(total area with modified
rational method)(Q=KCIA) is C = 0.795
Subarea runoff =      4.935(CFS) for    3.400(Ac.)
Total runoff =     23.326(CFS)
Effective area this stream =       12.90(Ac.)
Total Study Area (Main Stream No. 1) =       28.60(Ac.)
Area averaged Fm value =    0.266(In/Hr)
Depth of flow =   0.637(Ft.), Average velocity =  13.881(Ft/s)
Critical depth =      1.297(Ft.)


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Process from Point/Station       22.000 to Point/Station       23.000
**** IMPROVED CHANNEL TRAVEL TIME ****
------------------------------------------------------------------------
Upstream point elevation =  1021.000(Ft.)
Downstream point elevation =  1018.000(Ft.)
Channel length thru subarea  =   195.000(Ft.)
Channel base width     =    2.000(Ft.)
Slope or 'Z' of left channel bank =   1.000
Slope or 'Z' of right channel bank =   1.000
Estimated mean flow rate at midpoint of channel =     23.495(CFS)
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Manning's 'N'    = 0.015
Maximum depth of channel  =    3.000(Ft.)
Flow(q) thru subarea =     23.495(CFS)
Depth of flow =   0.930(Ft.), Average velocity =   8.627(Ft/s)
Channel flow top width =    3.859(Ft.)
Flow Velocity =    8.63(Ft/s)
Travel time  =    0.38 min.
Time of concentration =   12.01 min.
Critical depth =      1.297(Ft.)
 Adding area flow to channel
UNDEVELOPED (average cover) subarea
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 1.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.000
SCS curve number for soil(AMC 2)  = 69.00
Pervious ratio(Ap) = 1.0000     Max loss rate(Fm)=     0.548(In/Hr)
Rainfall intensity =      2.232(In/Hr) for a    10.0 year storm
Effective runoff coefficient used for area,(total area with modified
rational method)(Q=KCIA) is C = 0.789
Subarea runoff =      0.257(CFS) for    0.500(Ac.)
Total runoff =     23.583(CFS)
Effective area this stream =       13.40(Ac.)
Total Study Area (Main Stream No. 1) =       29.10(Ac.)
Area averaged Fm value =    0.276(In/Hr)
Depth of flow =   0.932(Ft.), Average velocity =   8.636(Ft/s)
Critical depth =      1.297(Ft.)


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Process from Point/Station       24.000 to Point/Station       23.000
**** SUBAREA FLOW ADDITION ****
------------------------------------------------------------------------
UNDEVELOPED (poor cover) subarea
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.700
Decimal fraction soil group C = 0.300
Decimal fraction soil group D = 0.000
SCS curve number for soil(AMC 2)  = 80.40
Pervious ratio(Ap) = 1.0000     Max loss rate(Fm)=     0.363(In/Hr)
Time of concentration =    12.01 min.
Rainfall intensity =      2.232(In/Hr) for a    10.0 year storm
Effective runoff coefficient used for area,(total area with modified
rational method)(Q=KCIA) is C = 0.787
Subarea runoff =      1.177(CFS) for    0.700(Ac.)
Total runoff =     24.760(CFS)
Effective area this stream =       14.10(Ac.)
Total Study Area (Main Stream No. 1) =       29.80(Ac.)
Area averaged Fm value =    0.281(In/Hr)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       23.000 to Point/Station       10.000
**** STREET FLOW TRAVEL TIME + SUBAREA FLOW ADDITION ****
```

```
Top of street segment elevation =  1018.000(Ft.)
End of street segment elevation =  1004.000(Ft.)
Length of street segment  =   595.000(Ft.)
Height of curb above gutter flowline  =    6.0(In.)
Width of half street (curb to crown)  =  17.000(Ft.)
Distance from crown to crossfall grade break  =   7.000(Ft.)
Slope from gutter to grade break (v/hz) =   0.020
Slope from grade break to crown (v/hz)  =   0.020
Street flow is on [1] side(s) of the street
Distance from curb to property line  =   7.000(Ft.)
Slope from curb to property line (v/hz) =   0.020
Gutter width =   2.000(Ft.)
Gutter hike from flowline =  2.000(In.)
 Manning's N in gutter =  0.0150
 Manning's N from gutter to grade break =  0.0150
 Manning's N from grade break to crown =  0.0150
Estimated mean flow rate at midpoint of street =     24.793(CFS)
Depth of flow =   0.547(Ft.), Average velocity =   5.594(Ft/s)
Warning: depth of flow exceeds top of curb
Note:  depth of flow exceeds top of street crown.
Distance that curb overflow reaches into property =    2.34(Ft.)
Streetflow hydraulics at midpoint of street travel:
Halfstreet flow width =  17.000(Ft.)
Flow velocity =   5.59(Ft/s)
Travel time =    1.77 min.     TC =   13.78  min.
 Adding area flow to street
COMMERCIAL subarea type
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 1.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.000
SCS curve number for soil(AMC 2)  = 56.00
Pervious ratio(Ap) = 0.1000     Max loss rate(Fm)=     0.073(In/Hr)
The area added to the existing stream causes a
a lower flow rate of Q =     23.584(CFS)
therefore the upstream flow rate of Q =     24.760(CFS) is being used
Rainfall intensity =      2.055(In/Hr) for a    10.0 year storm
Effective runoff coefficient used for area,(total area with modified
rational method)(Q=KCIA) is C = 0.781
Subarea runoff =      0.000(CFS) for    0.600(Ac.)
Total runoff =     24.760(CFS)
Effective area this stream =       14.70(Ac.)
Total Study Area (Main Stream No. 1) =       30.40(Ac.)
Area averaged Fm value =    0.272(In/Hr)
Street flow at end of street =     24.760(CFS)
Half street flow at end of street =     24.760(CFS)
Depth of flow =   0.546(Ft.), Average velocity =   5.592(Ft/s)
Warning: depth of flow exceeds top of curb
Note:  depth of flow exceeds top of street crown.
Distance that curb overflow reaches into property =    2.32(Ft.)
Flow width (from curb towards crown)=  17.000(Ft.)
```

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Process from Point/Station       10.000 to Point/Station       10.000
**** CONFLUENCE OF MINOR STREAMS ****
----------------------------------------------------------------------------
Along Main Stream number: 1 in normal stream number 2
Stream flow area =     14.700(Ac.)
Runoff from this stream =     24.760(CFS)
Time of concentration =   13.78 min.
Rainfall intensity =     2.055(In/Hr)
Area averaged loss rate (Fm) =    0.2722(In/Hr)
Area averaged Pervious ratio (Ap) = 0.9633


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Process from Point/Station       30.000 to Point/Station       31.000
**** INITIAL AREA EVALUATION ****
----------------------------------------------------------------------------
UNDEVELOPED (poor cover) subarea
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.050
Decimal fraction soil group C = 0.950
Decimal fraction soil group D = 0.000
SCS curve number for soil(AMC 2)  = 85.60
Pervious ratio(Ap) = 1.0000     Max loss rate(Fm)=     0.272(In/Hr)
Initial subarea data:
Initial area flow distance =  1000.000(Ft.)
Top (of initial area) elevation =  1248.000(Ft.)
Bottom (of initial area) elevation =  1080.000(Ft.)
Difference in elevation =   168.000(Ft.)
Slope =    0.16800  s(%)=      16.80
TC = k(0.525)*[(length^3)/(elevation change)]^0.2
Initial area time of concentration =   11.888 min.
Rainfall intensity =      2.245(In/Hr) for a    10.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.791
Subarea runoff =      8.523(CFS)
Total initial stream area =        4.800(Ac.)
Pervious area fraction = 1.000
Initial area Fm value =    0.272(In/Hr)


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Process from Point/Station       31.000 to Point/Station       32.000
**** IMPROVED CHANNEL TRAVEL TIME ****
----------------------------------------------------------------------------
Upstream point elevation =  1080.000(Ft.)
Downstream point elevation =  1072.200(Ft.)
Channel length thru subarea  =   520.000(Ft.)
Channel base width     =    0.000(Ft.)
Slope or 'Z' of left channel bank =   1.000
Slope or 'Z' of right channel bank =   1.000
Estimated mean flow rate at midpoint of channel =     11.940(CFS)
Manning's 'N'    = 0.015
Maximum depth of channel  =    2.000(Ft.)
Flow(q) thru subarea =     11.940(CFS)
```

```
Depth of flow =   1.289(Ft.), Average velocity =   7.185(Ft/s)
Channel flow top width =    2.578(Ft.)
Flow Velocity =    7.19(Ft/s)
Travel time  =    1.21 min.
Time of concentration =   13.09 min.
Critical depth =      1.547(Ft.)
 Adding area flow to channel
UNDEVELOPED (poor cover) subarea
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.050
Decimal fraction soil group C = 0.950
Decimal fraction soil group D = 0.000
SCS curve number for soil(AMC 2)  = 85.60
Pervious ratio(Ap) = 1.0000     Max loss rate(Fm)=     0.272(In/Hr)
Rainfall intensity =      2.119(In/Hr) for a    10.0 year storm
Effective runoff coefficient used for area,(total area with modified
rational method)(Q=KCIA) is C = 0.784
Subarea runoff =      6.766(CFS) for    4.400(Ac.)
Total runoff =     15.289(CFS)
Effective area this stream =        9.20(Ac.)
Total Study Area (Main Stream No. 1) =       39.60(Ac.)
Area averaged Fm value =    0.272(In/Hr)
Depth of flow =   1.414(Ft.), Average velocity =   7.644(Ft/s)
Critical depth =      1.703(Ft.)


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Process from Point/Station       32.000 to Point/Station       10.000
**** STREET FLOW TRAVEL TIME + SUBAREA FLOW ADDITION ****
------------------------------------------------------------------------
Top of street segment elevation =  1072.700(Ft.)
End of street segment elevation =  1004.000(Ft.)
Length of street segment  =   790.000(Ft.)
Height of curb above gutter flowline  =    6.0(In.)
Width of half street (curb to crown)  =  18.000(Ft.)
Distance from crown to crossfall grade break  =   7.000(Ft.)
Slope from gutter to grade break (v/hz) =   0.020
Slope from grade break to crown (v/hz)  =   0.020
Street flow is on [1] side(s) of the street
Distance from curb to property line  =   7.000(Ft.)
Slope from curb to property line (v/hz) =   0.020
Gutter width =   2.000(Ft.)
Gutter hike from flowline =  2.000(In.)
 Manning's N in gutter =  0.0150
 Manning's N from gutter to grade break =  0.0150
 Manning's N from grade break to crown =  0.0150
Estimated mean flow rate at midpoint of street =     15.320(CFS)
Depth of flow =   0.396(Ft.), Average velocity =   7.877(Ft/s)
Streetflow hydraulics at midpoint of street travel:
Halfstreet flow width =  13.484(Ft.)
Flow velocity =   7.88(Ft/s)
Travel time =    1.67 min.     TC =   14.77  min.
 Adding area flow to street
COMMERCIAL subarea type
```

```
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 1.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.000
SCS curve number for soil(AMC 2)  = 56.00
Pervious ratio(Ap) = 0.1000     Max loss rate(Fm)=     0.073(In/Hr)
The area added to the existing stream causes a
a lower flow rate of Q =     15.094(CFS)
therefore the upstream flow rate of Q =     15.289(CFS) is being used
Rainfall intensity =     1.971(In/Hr) for a    10.0 year storm
Effective runoff coefficient used for area,(total area with modified
rational method)(Q=KCIA) is C = 0.781
Subarea runoff =      0.000(CFS) for    0.600(Ac.)
Total runoff =     15.289(CFS)
Effective area this stream =        9.80(Ac.)
Total Study Area (Main Stream No. 1) =       40.20(Ac.)
Area averaged Fm value =    0.260(In/Hr)
Street flow at end of street =     15.289(CFS)
Half street flow at end of street =     15.289(CFS)
Depth of flow =   0.396(Ft.), Average velocity =   7.874(Ft/s)
Flow width (from curb towards crown)=  13.472(Ft.)


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Process from Point/Station       10.000 to Point/Station       10.000
**** CONFLUENCE OF MINOR STREAMS ****
------------------------------------------------------------------------
Along Main Stream number: 1 in normal stream number 3
Stream flow area =      9.800(Ac.)
Runoff from this stream =     15.289(CFS)
Time of concentration =   14.77 min.
Rainfall intensity =     1.971(In/Hr)
Area averaged loss rate (Fm) =    0.2601(In/Hr)
Area averaged Pervious ratio (Ap) = 0.9449
Summary of stream data:

Stream Flow rate    Area     TC      Fm       Rainfall Intensity
 No.     (CFS)    (Ac.)       (min) (In/Hr)      (In/Hr)


1     23.55    12.990     10.82    0.362      2.376
2     24.76    14.700     13.78    0.272      2.055
3     15.29     9.800     14.77    0.260      1.971
Qmax(1) =
         1.000 *    1.000 *    23.546) +
         1.180 *    0.785 *    24.760) +
         1.236 *    0.733 *    15.289) + =      60.334
Qmax(2) =
         0.841 *    1.000 *    23.546) +
         1.000 *    1.000 *    24.760) +
         1.049 *    0.933 *    15.289) + =      59.514
Qmax(3) =
         0.799 *    1.000 *    23.546) +
         0.953 *    1.000 *    24.760) +
```

```
          1.000 *    1.000 *    15.289) + =      57.704

Total of 3 streams to confluence:
Flow rates before confluence point:
      23.546      24.760      15.289
Maximum flow rates at confluence using above data:
       60.334       59.514       57.704
Area of streams before confluence:
       12.990       14.700        9.800
Effective area values after confluence:
       31.709       36.835       37.490
Results of confluence:
Total flow rate =     60.334(CFS)
Time of concentration =    10.817 min.
Effective stream area after confluence =     31.709(Ac.)
Study area average Pervious fraction(Ap) =  0.805
Study area average soil loss rate(Fm) =    0.300(In/Hr)
Study area total (this main stream) =      37.49(Ac.)
End of computations, Total Study Area =           40.20 (Ac.)
The following figures may
be used for a unit hydrograph study of the same area.
Note: These figures do not consider reduced effective area
effects caused by confluences in the rational equation.

Area averaged pervious area fraction(Ap) = 0.784
Area averaged SCS curve number =  73.6
```

San Bernardino County Rational Hydrology Program

(Hydrology Manual Date - August 1986)

CIVILCADD/CIVILDESIGN Engineering Software, (c) 1989-2005 Version 7.1
Rational Hydrology Study Date: 09/26/16

Tr 18233
10-Year Hydrology Study
Developed Condition Area "B"

Program License Serial Number 6194

********* Hydrology Study Control Information **********

Rational hydrology study storm event year is 10.0
Computed rainfall intensity:
Storm year = 10.00 1 hour rainfall = 0.850 (In.)
Slope used for rainfall intensity curve b = 0.6000
Soil antecedent moisture condition (AMC) = 2

++
Process from Point/Station 40.000 to Point/Station 42.000
**** INITIAL AREA EVALUATION ****

RESIDENTIAL(1 acre lot)
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.200
Decimal fraction soil group C = 0.800
Decimal fraction soil group D = 0.000
SCS curve number for soil(AMC 2) = 66.40
Pervious ratio(Ap) = 0.8000 Max loss rate(Fm)= 0.470(In/Hr)
Initial subarea data:
Initial area flow distance = 610.000(Ft.)
Top (of initial area) elevation = 1134.000(Ft.)
Bottom (of initial area) elevation = 1030.000(Ft.)
Difference in elevation = 104.000(Ft.)
Slope = 0.17049 s(%)= 17.05
TC = k(0.469)*[(length^3)/(elevation change)]^0.2
Initial area time of concentration = 8.689 min.
Rainfall intensity = 2.710(In/Hr) for a 10.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.744
Subarea runoff = 5.241(CFS)
Total initial stream area = 2.600(Ac.)
Pervious area fraction = 0.800
Initial area Fm value = 0.470(In/Hr)

```
++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       42.000 to Point/Station       42.000
**** CONFLUENCE OF MINOR STREAMS ****

------------------------------------------------------------------------------
Along Main Stream number: 1 in normal stream number 1
Stream flow area =      2.600(Ac.)
Runoff from this stream =      5.241(CFS)
Time of concentration =    8.69 min.
Rainfall intensity =     2.710(In/Hr)
Area averaged loss rate (Fm) =    0.4699(In/Hr)
Area averaged Pervious ratio (Ap) = 0.8000


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Process from Point/Station       41.000 to Point/Station       42.000
**** INITIAL AREA EVALUATION ****

------------------------------------------------------------------------------
UNDEVELOPED (poor cover) subarea
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 1.000
Decimal fraction soil group D = 0.000
SCS curve number for soil(AMC 2)  = 86.00
Pervious ratio(Ap) = 1.0000     Max loss rate(Fm)=     0.265(In/Hr)
Initial subarea data:
Initial area flow distance =   500.000(Ft.)
Top (of initial area) elevation =  1134.000(Ft.)
Bottom (of initial area) elevation =  1030.000(Ft.)
Difference in elevation =   104.000(Ft.)
Slope =    0.20800  s(%)=      20.80
TC = k(0.525)*[(length^3)/(elevation change)]^0.2
Initial area time of concentration =    8.632 min.
Rainfall intensity =      2.720(In/Hr) for a    10.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.812
Subarea runoff =      3.315(CFS)
Total initial stream area =        1.500(Ac.)
Pervious area fraction = 1.000
Initial area Fm value =    0.265(In/Hr)


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Process from Point/Station       42.000 to Point/Station       42.000
**** CONFLUENCE OF MINOR STREAMS ****

------------------------------------------------------------------------------
Along Main Stream number: 1 in normal stream number 2
Stream flow area =      1.500(Ac.)
Runoff from this stream =      3.315(CFS)
Time of concentration =    8.63 min.
Rainfall intensity =     2.720(In/Hr)
Area averaged loss rate (Fm) =    0.2651(In/Hr)
Area averaged Pervious ratio (Ap) = 1.0000
Summary of stream data:
```

```
Stream Flow rate    Area     TC      Fm       Rainfall Intensity
 No.    (CFS)    (Ac.)      (min)  (In/Hr)     (In/Hr)


1      5.24     2.600      8.69    0.470      2.710
2      3.31     1.500      8.63    0.265      2.720
Qmax(1) =
         1.000 *    1.000 *     5.241) +
         0.996 *    1.000 *     3.315) + =       8.542
Qmax(2) =
         1.005 *    0.994 *     5.241) +
         1.000 *    1.000 *     3.315) + =       8.547

Total of 2 streams to confluence:
Flow rates before confluence point:
       5.241       3.315
Maximum flow rates at confluence using above data:
       8.542       8.547
Area of streams before confluence:
       2.600       1.500
Effective area values after confluence:
       4.100       4.083
Results of confluence:
Total flow rate =      8.547(CFS)
Time of concentration =     8.632 min.
Effective stream area after confluence =      4.083(Ac.)
Study area average Pervious fraction(Ap) =  0.873
Study area average soil loss rate(Fm) =    0.395(In/Hr)
Study area total (this main stream) =       4.10(Ac.)


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Process from Point/Station       42.000 to Point/Station       47.000
**** STREET FLOW TRAVEL TIME + SUBAREA FLOW ADDITION ****
------------------------------------------------------------------------
Top of street segment elevation =  1030.000(Ft.)
End of street segment elevation =  1009.000(Ft.)
Length of street segment   =   270.000(Ft.)
Height of curb above gutter flowline   =    6.0(In.)
Width of half street (curb to crown)   =  18.000(Ft.)
Distance from crown to crossfall grade break   =  10.000(Ft.)
Slope from gutter to grade break (v/hz) =   0.020
Slope from grade break to crown (v/hz)  =   0.020
Street flow is on [1] side(s) of the street
Distance from curb to property line   =   7.000(Ft.)
Slope from curb to property line (v/hz) =   0.020
Gutter width =   2.000(Ft.)
Gutter hike from flowline =  2.000(In.)
 Manning's N in gutter =  0.0150
 Manning's N from gutter to grade break =  0.0150
 Manning's N from grade break to crown =  0.0150
Estimated mean flow rate at midpoint of street =      9.263(CFS)
Depth of flow =   0.351(Ft.), Average velocity =   6.703(Ft/s)
Streetflow hydraulics at midpoint of street travel:
```

```
Halfstreet flow width =  11.203(Ft.)
Flow velocity =   6.70(Ft/s)
Travel time =    0.67 min.     TC =    9.30  min.
 Adding area flow to street
RESIDENTIAL(3 - 4 dwl/acre)
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.350
Decimal fraction soil group C = 0.650
Decimal fraction soil group D = 0.000
SCS curve number for soil(AMC 2)  = 64.45
Pervious ratio(Ap) = 0.6000     Max loss rate(Fm)=     0.370(In/Hr)
Rainfall intensity =      2.601(In/Hr) for a    10.0 year storm
Effective runoff coefficient used for area,(total area with modified
rational method)(Q=KCIA) is C = 0.765
Subarea runoff =      1.367(CFS) for    0.900(Ac.)
Total runoff =      9.913(CFS)
Effective area this stream =        4.98(Ac.)
Total Study Area (Main Stream No. 1) =        5.00(Ac.)
Area averaged Fm value =    0.390(In/Hr)
Street flow at end of street =      9.913(CFS)
Half street flow at end of street =      9.913(CFS)
Depth of flow =   0.357(Ft.), Average velocity =   6.810(Ft/s)
Flow width (from curb towards crown)=  11.528(Ft.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       47.000 to Point/Station       47.000
**** CONFLUENCE OF MAIN STREAMS ****
------------------------------------------------------------------------------
The following data inside Main Stream is listed:
In Main Stream number: 1
Stream flow area =      4.983(Ac.)
Runoff from this stream =      9.913(CFS)
Time of concentration =    9.30 min.
Rainfall intensity =     2.601(In/Hr)
Area averaged loss rate (Fm) =    0.3904(In/Hr)
Area averaged Pervious ratio (Ap) = 0.8238
Program is now starting with Main Stream No. 2


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       43.000 to Point/Station       44.000
**** INITIAL AREA EVALUATION ****
------------------------------------------------------------------------------
UNDEVELOPED (poor cover) subarea
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 1.000
Decimal fraction soil group D = 0.000
SCS curve number for soil(AMC 2)  = 86.00
Pervious ratio(Ap) = 1.0000     Max loss rate(Fm)=     0.265(In/Hr)
Initial subarea data:
Initial area flow distance =   370.000(Ft.)
Top (of initial area) elevation =  1132.000(Ft.)
```

```
Bottom (of initial area) elevation =  1032.000(Ft.)
Difference in elevation =   100.000(Ft.)
Slope =    0.27027  s(%)=      27.03
TC = k(0.525)*[(length^3)/(elevation change)]^0.2
Initial area time of concentration =    7.262 min.
Rainfall intensity =      3.018(In/Hr) for a    10.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.821
Subarea runoff =      2.725(CFS)
Total initial stream area =        1.100(Ac.)
Pervious area fraction = 1.000
Initial area Fm value =    0.265(In/Hr)


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Process from Point/Station       44.000 to Point/Station       46.000
**** IMPROVED CHANNEL TRAVEL TIME ****
------------------------------------------------------------------------
Upstream point elevation =  1032.000(Ft.)
Downstream point elevation =  1030.000(Ft.)
Channel length thru subarea  =   160.000(Ft.)
Channel base width     =    0.000(Ft.)
Slope or 'Z' of left channel bank =   1.000
Slope or 'Z' of right channel bank =   1.000
Estimated mean flow rate at midpoint of channel =      5.443(CFS)
Manning's 'N'    = 0.015
Maximum depth of channel  =    2.000(Ft.)
Flow(q) thru subarea =      5.443(CFS)
Depth of flow =   0.994(Ft.), Average velocity =   5.514(Ft/s)
Channel flow top width =    1.987(Ft.)
Flow Velocity =    5.51(Ft/s)
Travel time  =    0.48 min.
Time of concentration =    7.75 min.
Critical depth =      1.133(Ft.)
 Adding area flow to channel
UNDEVELOPED (poor cover) subarea
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 1.000
Decimal fraction soil group D = 0.000
SCS curve number for soil(AMC 2)  = 86.00
Pervious ratio(Ap) = 1.0000     Max loss rate(Fm)=     0.265(In/Hr)
Rainfall intensity =      2.903(In/Hr) for a    10.0 year storm
Effective runoff coefficient used for area,(total area with modified
rational method)(Q=KCIA) is C = 0.818
Subarea runoff =      5.347(CFS) for    2.300(Ac.)
Total runoff =      8.072(CFS)
Effective area this stream =        3.40(Ac.)
Total Study Area (Main Stream No. 2) =        8.40(Ac.)
Area averaged Fm value =    0.265(In/Hr)
Depth of flow =   1.152(Ft.), Average velocity =   6.085(Ft/s)
Critical depth =      1.320(Ft.)


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Process from Point/Station       46.000 to Point/Station       46.000
**** CONFLUENCE OF MINOR STREAMS ****
------------------------------------------------------------------------
Along Main Stream number: 2 in normal stream number 1
Stream flow area =      3.400(Ac.)
Runoff from this stream =      8.072(CFS)
Time of concentration =    7.75 min.
Rainfall intensity =     2.903(In/Hr)
Area averaged loss rate (Fm) =    0.2651(In/Hr)
Area averaged Pervious ratio (Ap) = 1.0000


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       45.000 to Point/Station       46.000
**** INITIAL AREA EVALUATION ****
------------------------------------------------------------------------
UNDEVELOPED (poor cover) subarea
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 1.000
Decimal fraction soil group D = 0.000
SCS curve number for soil(AMC 2)  = 86.00
Pervious ratio(Ap) = 1.0000     Max loss rate(Fm)=     0.265(In/Hr)
Initial subarea data:
Initial area flow distance =   560.000(Ft.)
Top (of initial area) elevation =  1250.000(Ft.)
Bottom (of initial area) elevation =  1032.000(Ft.)
Difference in elevation =   218.000(Ft.)
Slope =    0.38929  s(%)=      38.93
TC = k(0.525)*[(length^3)/(elevation change)]^0.2
Initial area time of concentration =    7.969 min.
Rainfall intensity =      2.854(In/Hr) for a    10.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.816
Subarea runoff =      2.097(CFS)
Total initial stream area =        0.900(Ac.)
Pervious area fraction = 1.000
Initial area Fm value =    0.265(In/Hr)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       46.000 to Point/Station       46.000
**** CONFLUENCE OF MINOR STREAMS ****
------------------------------------------------------------------------
Along Main Stream number: 2 in normal stream number 2
Stream flow area =      0.900(Ac.)
Runoff from this stream =      2.097(CFS)
Time of concentration =    7.97 min.
Rainfall intensity =     2.854(In/Hr)
Area averaged loss rate (Fm) =    0.2651(In/Hr)
Area averaged Pervious ratio (Ap) = 1.0000
Summary of stream data:

Stream Flow rate    Area     TC      Fm       Rainfall Intensity
 No.     (CFS)    (Ac.)       (min)  (In/Hr)      (In/Hr)
```

```
1       8.07      3.400       7.75     0.265       2.903
2       2.10      0.900       7.97     0.265       2.854
Qmax(1) =
          1.000 *     1.000 *      8.072) +
          1.019 *     0.972 *      2.097) + =       10.149
Qmax(2) =
          0.981 *     1.000 *      8.072) +
          1.000 *     1.000 *      2.097) + =       10.020

Total of 2 streams to confluence:
Flow rates before confluence point:
        8.072       2.097
Maximum flow rates at confluence using above data:
       10.149       10.020
Area of streams before confluence:
        3.400       0.900
Effective area values after confluence:
        4.275       4.300
Results of confluence:
Total flow rate =      10.149(CFS)
Time of concentration =      7.746 min.
Effective stream area after confluence =       4.275(Ac.)
Study area average Pervious fraction(Ap) =  1.000
Study area average soil loss rate(Fm) =    0.265(In/Hr)
Study area total (this main stream) =       4.30(Ac.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       46.000 to Point/Station       47.000
**** STREET FLOW TRAVEL TIME + SUBAREA FLOW ADDITION ****
------------------------------------------------------------------------------
Top of street segment elevation =  1030.000(Ft.)
End of street segment elevation =  1009.000(Ft.)
Length of street segment  =   200.000(Ft.)
Height of curb above gutter flowline  =    6.0(In.)
Width of half street (curb to crown)  =  18.000(Ft.)
Distance from crown to crossfall grade break  =  10.000(Ft.)
Slope from gutter to grade break (v/hz) =   0.020
Slope from grade break to crown (v/hz)  =   0.020
Street flow is on [1] side(s) of the street
Distance from curb to property line  =   7.000(Ft.)
Slope from curb to property line (v/hz) =   0.020
Gutter width =   2.000(Ft.)
Gutter hike from flowline =  2.000(In.)
 Manning's N in gutter =  0.0150
 Manning's N from gutter to grade break =  0.0150
 Manning's N from grade break to crown =  0.0150
Estimated mean flow rate at midpoint of street =     10.779(CFS)
Depth of flow =   0.351(Ft.), Average velocity =   7.791(Ft/s)
Streetflow hydraulics at midpoint of street travel:
Halfstreet flow width =  11.211(Ft.)
Flow velocity =   7.79(Ft/s)
```

```
Travel time =    0.43 min.     TC =    8.17  min.
 Adding area flow to street
RESIDENTIAL(3 - 4 dwl/acre)
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.100
Decimal fraction soil group C = 0.900
Decimal fraction soil group D = 0.000
SCS curve number for soil(AMC 2)  = 67.70
Pervious ratio(Ap) = 0.6000     Max loss rate(Fm)=     0.341(In/Hr)
Rainfall intensity =      2.811(In/Hr) for a    10.0 year storm
Effective runoff coefficient used for area,(total area with modified
rational method)(Q=KCIA) is C = 0.812
Subarea runoff =      1.202(CFS) for    0.700(Ac.)
Total runoff =     11.351(CFS)
Effective area this stream =        4.97(Ac.)
Total Study Area (Main Stream No. 2) =       10.00(Ac.)
Area averaged Fm value =    0.276(In/Hr)
Street flow at end of street =     11.351(CFS)
Half street flow at end of street =     11.351(CFS)
Depth of flow =   0.356(Ft.), Average velocity =   7.886(Ft/s)
Flow width (from curb towards crown)=  11.458(Ft.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       47.000 to Point/Station       47.000
**** CONFLUENCE OF MAIN STREAMS ****
------------------------------------------------------------------------
The following data inside Main Stream is listed:
In Main Stream number: 2
Stream flow area =      4.975(Ac.)
Runoff from this stream =     11.351(CFS)
Time of concentration =    8.17 min.
Rainfall intensity =     2.811(In/Hr)
Area averaged loss rate (Fm) =    0.2757(In/Hr)
Area averaged Pervious ratio (Ap) = 0.9437
Summary of stream data:

Stream Flow rate    Area     TC      Fm       Rainfall Intensity
 No.     (CFS)    (Ac.)       (min)  (In/Hr)      (In/Hr)


1       9.91      4.983       9.30    0.390       2.601
2      11.35      4.975       8.17    0.276       2.811
Qmax(1) =
          1.000 *    1.000 *     9.913) +
          0.917 *    1.000 *    11.351) + =      20.324
Qmax(2) =
          1.095 *    0.879 *     9.913) +
          1.000 *    1.000 *    11.351) + =      20.888

Total of 2 main streams to confluence:
Flow rates before confluence point:
      10.913      12.351
Maximum flow rates at confluence using above data:
```

```
       20.324       20.888
Area of streams before confluence:
        4.983        4.975
Effective area values after confluence:
        9.958        9.353


Results of confluence:
Total flow rate =     20.888(CFS)
Time of concentration =     8.174 min.
Effective stream area after confluence  =      9.353(Ac.)
Study area average Pervious fraction(Ap) =  0.884
Study area average soil loss rate(Fm) =    0.333(In/Hr)
Study area total =       9.96(Ac.)
End of computations, Total Study Area =           10.00 (Ac.)
The following figures may
be used for a unit hydrograph study of the same area.
Note: These figures do not consider reduced effective area
effects caused by confluences in the rational equation.

Area averaged pervious area fraction(Ap) = 0.884
Area averaged SCS curve number =  77.7
```

San Bernardino County Rational Hydrology Program

(Hydrology Manual Date - August 1986)

CIVILCADD/CIVILDESIGN Engineering Software, (c) 1989-2005 Version 7.1
Rational Hydrology Study Date: 09/26/16

Tr 18233
100-Year Hydrology Study
Developed Condition Area "A"

Program License Serial Number 6194

********* Hydrology Study Control Information **********

Rational hydrology study storm event year is 100.0
Computed rainfall intensity:
Storm year = 100.00 1 hour rainfall = 1.200 (In.)
Slope used for rainfall intensity curve b = 0.6000
Soil antecedent moisture condition (AMC) = 3

++
Process from Point/Station 1.000 to Point/Station 6.000
**** INITIAL AREA EVALUATION ****

RESIDENTIAL(5 - 7 dwl/acre)
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 1.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.000
SCS curve number for soil(AMC 2) = 56.00
Adjusted SCS curve number for AMC 3 = 75.80
Pervious ratio(Ap) = 0.5000 Max loss rate(Fm)= 0.220(In/Hr)
Initial subarea data:
Initial area flow distance = 805.000(Ft.)
Top (of initial area) elevation = 65.800(Ft.)
Bottom (of initial area) elevation = 15.000(Ft.)
Difference in elevation = 50.800(Ft.)
Slope = 0.06311 s(%)= 6.31
TC = k(0.389)*[(length^3)/(elevation change)]^0.2
Initial area time of concentration = 9.823 min.
Rainfall intensity = 3.554(In/Hr) for a 100.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.844
Subarea runoff = 3.601(CFS)
Total initial stream area = 1.200(Ac.)
Pervious area fraction = 0.500
Initial area Fm value = 0.220(In/Hr)

```
++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station        6.000 to Point/Station        6.000
**** CONFLUENCE OF MINOR STREAMS ****
------------------------------------------------------------------------------
Along Main Stream number: 1 in normal stream number 1
Stream flow area =      1.200(Ac.)
Runoff from this stream =      3.601(CFS)
Time of concentration =    9.82 min.
Rainfall intensity =     3.554(In/Hr)
Area averaged loss rate (Fm) =    0.2200(In/Hr)
Area averaged Pervious ratio (Ap) = 0.5000


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station        2.000 to Point/Station        6.000
**** INITIAL AREA EVALUATION ****
------------------------------------------------------------------------------
RESIDENTIAL(5 - 7 dwl/acre)
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 1.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.000
SCS curve number for soil(AMC 2)  = 56.00
Adjusted SCS curve number for AMC 3 = 75.80
Pervious ratio(Ap) = 0.5000     Max loss rate(Fm)=     0.220(In/Hr)
Initial subarea data:
Initial area flow distance =   900.000(Ft.)
Top (of initial area) elevation =    66.700(Ft.)
Bottom (of initial area) elevation =    15.000(Ft.)
Difference in elevation =    51.700(Ft.)
Slope =    0.05744  s(%)=       5.74
TC = k(0.389)*[(length^3)/(elevation change)]^0.2
Initial area time of concentration =   10.466 min.
Rainfall intensity =      3.421(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.842
Subarea runoff =      6.339(CFS)
Total initial stream area =        2.200(Ac.)
Pervious area fraction = 0.500
Initial area Fm value =    0.220(In/Hr)


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Process from Point/Station        6.000 to Point/Station        6.000
**** CONFLUENCE OF MINOR STREAMS ****
------------------------------------------------------------------------------
Along Main Stream number: 1 in normal stream number 2
Stream flow area =      2.200(Ac.)
Runoff from this stream =      6.339(CFS)
Time of concentration =   10.47 min.
Rainfall intensity =     3.421(In/Hr)
Area averaged loss rate (Fm) =    0.2200(In/Hr)
Area averaged Pervious ratio (Ap) = 0.5000
```

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++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station        3.000 to Point/Station        6.000
**** INITIAL AREA EVALUATION ****

------------------------------------------------------------------------------
RESIDENTIAL(5 - 7 dwl/acre)
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 1.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.000
SCS curve number for soil(AMC 2)  = 56.00
Adjusted SCS curve number for AMC 3 = 75.80
Pervious ratio(Ap) = 0.5000     Max loss rate(Fm)=     0.220(In/Hr)
Initial subarea data:
Initial area flow distance =   615.000(Ft.)
Top (of initial area) elevation =    57.000(Ft.)
Bottom (of initial area) elevation =    15.000(Ft.)
Difference in elevation =    42.000(Ft.)
Slope =    0.06829  s(%)=       6.83
TC = k(0.389)*[(length^3)/(elevation change)]^0.2
Initial area time of concentration =    8.682 min.
Rainfall intensity =      3.827(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.848
Subarea runoff =      4.870(CFS)
Total initial stream area =        1.500(Ac.)
Pervious area fraction = 0.500
Initial area Fm value =    0.220(In/Hr)


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Process from Point/Station        6.000 to Point/Station        6.000
**** CONFLUENCE OF MINOR STREAMS ****

------------------------------------------------------------------------------
Along Main Stream number: 1 in normal stream number 3
Stream flow area =      1.500(Ac.)
Runoff from this stream =      4.870(CFS)
Time of concentration =    8.68 min.
Rainfall intensity =     3.827(In/Hr)
Area averaged loss rate (Fm) =    0.2200(In/Hr)
Area averaged Pervious ratio (Ap) = 0.5000


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Process from Point/Station        4.000 to Point/Station        5.000
**** INITIAL AREA EVALUATION ****

------------------------------------------------------------------------------
RESIDENTIAL(5 - 7 dwl/acre)
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.610
Decimal fraction soil group C = 0.390
Decimal fraction soil group D = 0.000
SCS curve number for soil(AMC 2)  = 61.07
Adjusted SCS curve number for AMC 3 = 79.86
```

```
Pervious ratio(Ap) = 0.5000     Max loss rate(Fm)=     0.186(In/Hr)
Initial subarea data:
Initial area flow distance =   960.000(Ft.)
Top (of initial area) elevation =    73.000(Ft.)
Bottom (of initial area) elevation =    21.000(Ft.)
Difference in elevation =    52.000(Ft.)
Slope =    0.05417  s(%)=       5.42
TC = k(0.389)*[(length^3)/(elevation change)]^0.2
Initial area time of concentration =   10.867 min.
Rainfall intensity =      3.345(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.850
Subarea runoff =      6.539(CFS)
Total initial stream area =        2.300(Ac.)
Pervious area fraction = 0.500
Initial area Fm value =    0.186(In/Hr)


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Process from Point/Station        5.000 to Point/Station        6.000
**** STREET FLOW TRAVEL TIME + SUBAREA FLOW ADDITION ****
------------------------------------------------------------------------------
Top of street segment elevation =    21.000(Ft.)
End of street segment elevation =    15.000(Ft.)
Length of street segment  =   180.000(Ft.)
Height of curb above gutter flowline  =    6.0(In.)
Width of half street (curb to crown)  =  18.000(Ft.)
Distance from crown to crossfall grade break  =  10.000(Ft.)
Slope from gutter to grade break (v/hz) =   0.020
Slope from grade break to crown (v/hz)  =   0.020
Street flow is on [1] side(s) of the street
Distance from curb to property line  =   7.000(Ft.)
Slope from curb to property line (v/hz) =   0.020
Gutter width =   2.000(Ft.)
Gutter hike from flowline =  2.000(In.)
 Manning's N in gutter =  0.0150
 Manning's N from gutter to grade break =  0.0150
 Manning's N from grade break to crown =  0.0150
Estimated mean flow rate at midpoint of street =      6.997(CFS)
Depth of flow =   0.365(Ft.), Average velocity =   4.538(Ft/s)
Streetflow hydraulics at midpoint of street travel:
Halfstreet flow width =  11.897(Ft.)
Flow velocity =   4.54(Ft/s)
Travel time =    0.66 min.     TC =   11.53  min.
 Adding area flow to street
RESIDENTIAL(5 - 7 dwl/acre)
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 1.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.000
SCS curve number for soil(AMC 2)  = 56.00
Adjusted SCS curve number for AMC 3 = 75.80
Pervious ratio(Ap) = 0.5000     Max loss rate(Fm)=     0.220(In/Hr)
Rainfall intensity =      3.229(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for area,(total area with modified
```

```
rational method)(Q=KCIA) is C = 0.847
Subarea runoff =      0.842(CFS) for    0.400(Ac.)
Total runoff =      7.381(CFS)
Effective area this stream =        2.70(Ac.)
Total Study Area (Main Stream No. 1) =        7.60(Ac.)
Area averaged Fm value =    0.191(In/Hr)
Street flow at end of street =      7.381(CFS)
Half street flow at end of street =      7.381(CFS)
Depth of flow =   0.370(Ft.), Average velocity =   4.595(Ft/s)
Flow width (from curb towards crown)=  12.164(Ft.)


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Process from Point/Station        6.000 to Point/Station        6.000
**** CONFLUENCE OF MINOR STREAMS ****
------------------------------------------------------------------------------
Along Main Stream number: 1 in normal stream number 4
Stream flow area =      2.700(Ac.)
Runoff from this stream =      7.381(CFS)
Time of concentration =   11.53 min.
Rainfall intensity =     3.229(In/Hr)
Area averaged loss rate (Fm) =    0.1911(In/Hr)
Area averaged Pervious ratio (Ap) = 0.5000
Summary of stream data:

Stream Flow rate    Area     TC      Fm       Rainfall Intensity
 No.     (CFS)    (Ac.)       (min)  (In/Hr)      (In/Hr)


1       3.60      1.200       9.82    0.220       3.554
2       6.34      2.200      10.47    0.220       3.421
3       4.87      1.500       8.68    0.220       3.827
4       7.38      2.700      11.53    0.191       3.229
Qmax(1) =
          1.000 *    1.000 *     3.601) +
          1.041 *    0.939 *     6.339) +
          0.924 *    1.000 *     4.870) +
          1.107 *    0.852 *     7.381) + =      21.261
Qmax(2) =
          0.960 *    1.000 *     3.601) +
          1.000 *    1.000 *     6.339) +
          0.887 *    1.000 *     4.870) +
          1.063 *    0.908 *     7.381) + =      21.244
Qmax(3) =
          1.082 *    0.884 *     3.601) +
          1.127 *    0.830 *     6.339) +
          1.000 *    1.000 *     4.870) +
          1.197 *    0.753 *     7.381) + =      20.893
Qmax(4) =
          0.902 *    1.000 *     3.601) +
          0.940 *    1.000 *     6.339) +
          0.834 *    1.000 *     4.870) +
          1.000 *    1.000 *     7.381) + =      20.649
```

```
Total of 4 streams to confluence:
Flow rates before confluence point:
       3.601       6.339       4.870       7.381
Maximum flow rates at confluence using above data:
       21.261      21.244      20.893      20.649
Area of streams before confluence:
        1.200       2.200       1.500       2.700
Effective area values after confluence:
        7.066       7.351       6.419       7.600
Results of confluence:
Total flow rate =     21.261(CFS)
Time of concentration =     9.823 min.
Effective stream area after confluence =      7.066(Ac.)
Study area average Pervious fraction(Ap) =  0.500
Study area average soil loss rate(Fm) =    0.210(In/Hr)
Study area total (this main stream) =       7.60(Ac.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station        6.000 to Point/Station        9.000
**** STREET FLOW TRAVEL TIME + SUBAREA FLOW ADDITION ****
------------------------------------------------------------------------------
Top of street segment elevation =    15.000(Ft.)
End of street segment elevation =    13.200(Ft.)
Length of street segment  =   160.000(Ft.)
Height of curb above gutter flowline  =    6.0(In.)
Width of half street (curb to crown)  =  18.000(Ft.)
Distance from crown to crossfall grade break  =  10.000(Ft.)
Slope from gutter to grade break (v/hz) =   0.020
Slope from grade break to crown (v/hz)  =   0.020
Street flow is on [2] side(s) of the street
Distance from curb to property line  =   7.000(Ft.)
Slope from curb to property line (v/hz) =   0.020
Gutter width =   2.000(Ft.)
Gutter hike from flowline =  2.000(In.)
 Manning's N in gutter =  0.0150
 Manning's N from gutter to grade break =  0.0150
 Manning's N from grade break to crown =  0.0150
Estimated mean flow rate at midpoint of street =     21.528(CFS)
Depth of flow =   0.479(Ft.), Average velocity =   3.331(Ft/s)
Streetflow hydraulics at midpoint of street travel:
Halfstreet flow width =  17.622(Ft.)
Flow velocity =   3.33(Ft/s)
Travel time =    0.80 min.     TC =   10.62  min.
 Adding area flow to street
RESIDENTIAL(5 - 7 dwl/acre)
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 1.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.000
SCS curve number for soil(AMC 2)  = 56.00
Adjusted SCS curve number for AMC 3 = 75.80
Pervious ratio(Ap) = 0.5000     Max loss rate(Fm)=     0.220(In/Hr)
Rainfall intensity =      3.391(In/Hr) for a   100.0 year storm
```

```
Effective runoff coefficient used for area,(total area with modified
rational method)(Q=KCIA) is C = 0.844
Subarea runoff =      0.394(CFS) for    0.500(Ac.)
Total runoff =     21.655(CFS)
Effective area this stream =        7.57(Ac.)
Total Study Area (Main Stream No. 1) =        8.10(Ac.)
Area averaged Fm value =    0.210(In/Hr)
Street flow at end of street =     21.655(CFS)
Half street flow at end of street =     10.828(CFS)
Depth of flow =   0.480(Ft.), Average velocity =   3.335(Ft/s)
Flow width (from curb towards crown)=  17.663(Ft.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station        9.000 to Point/Station        9.000
**** CONFLUENCE OF MINOR STREAMS ****
------------------------------------------------------------------------
Along Main Stream number: 1 in normal stream number 1
Stream flow area =      7.566(Ac.)
Runoff from this stream =     21.655(CFS)
Time of concentration =   10.62 min.
Rainfall intensity =     3.391(In/Hr)
Area averaged loss rate (Fm) =    0.2104(In/Hr)
Area averaged Pervious ratio (Ap) = 0.5000


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station        7.000 to Point/Station        8.000
**** INITIAL AREA EVALUATION ****
------------------------------------------------------------------------
RESIDENTIAL(5 - 7 dwl/acre)
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.890
Decimal fraction soil group C = 0.110
Decimal fraction soil group D = 0.000
SCS curve number for soil(AMC 2)  = 57.43
Adjusted SCS curve number for AMC 3 = 76.94
Pervious ratio(Ap) = 0.5000     Max loss rate(Fm)=     0.211(In/Hr)
Initial subarea data:
Initial area flow distance =   810.000(Ft.)
Top (of initial area) elevation =    72.400(Ft.)
Bottom (of initial area) elevation =    57.000(Ft.)
Difference in elevation =    15.400(Ft.)
Slope =    0.01901  s(%)=       1.90
TC = k(0.389)*[(length^3)/(elevation change)]^0.2
Initial area time of concentration =   12.518 min.
Rainfall intensity =      3.073(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.838
Subarea runoff =      6.183(CFS)
Total initial stream area =        2.400(Ac.)
Pervious area fraction = 0.500
Initial area Fm value =    0.211(In/Hr)
```

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++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station        8.000 to Point/Station        9.000
**** STREET FLOW TRAVEL TIME + SUBAREA FLOW ADDITION ****
------------------------------------------------------------------------------
Top of street segment elevation =    57.000(Ft.)
End of street segment elevation =    13.200(Ft.)
Length of street segment  =   810.000(Ft.)
Height of curb above gutter flowline  =    6.0(In.)
Width of half street (curb to crown)  =  18.000(Ft.)
Distance from crown to crossfall grade break  =  10.000(Ft.)
Slope from gutter to grade break (v/hz) =   0.020
Slope from grade break to crown (v/hz)  =   0.020
Street flow is on [2] side(s) of the street
Distance from curb to property line  =   7.000(Ft.)
Slope from curb to property line (v/hz) =   0.020
Gutter width =   2.000(Ft.)
Gutter hike from flowline =  2.000(In.)
 Manning's N in gutter =  0.0150
 Manning's N from gutter to grade break =  0.0150
 Manning's N from grade break to crown =  0.0150
Estimated mean flow rate at midpoint of street =     11.237(CFS)
Depth of flow =   0.322(Ft.), Average velocity =   5.194(Ft/s)
Streetflow hydraulics at midpoint of street travel:
Halfstreet flow width =   9.772(Ft.)
Flow velocity =   5.19(Ft/s)
Travel time =    2.60 min.     TC =   15.12  min.
 Adding area flow to street
RESIDENTIAL(5 - 7 dwl/acre)
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 1.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.000
SCS curve number for soil(AMC 2)  = 56.00
Adjusted SCS curve number for AMC 3 = 75.80
Pervious ratio(Ap) = 0.5000     Max loss rate(Fm)=     0.220(In/Hr)
Rainfall intensity =      2.744(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for area,(total area with modified
rational method)(Q=KCIA) is C = 0.829
Subarea runoff =      9.966(CFS) for    4.700(Ac.)
Total runoff =     16.149(CFS)
Effective area this stream =        7.10(Ac.)
Total Study Area (Main Stream No. 1) =       15.20(Ac.)
Area averaged Fm value =    0.217(In/Hr)
Street flow at end of street =     16.149(CFS)
Half street flow at end of street =      8.075(CFS)
Depth of flow =   0.355(Ft.), Average velocity =   5.647(Ft/s)
Flow width (from curb towards crown)=  11.415(Ft.)


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Process from Point/Station        9.000 to Point/Station        9.000
**** CONFLUENCE OF MINOR STREAMS ****
------------------------------------------------------------------------------
Along Main Stream number: 1 in normal stream number 2
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```
Stream flow area =      7.100(Ac.)
Runoff from this stream =     16.149(CFS)
Time of concentration =   15.12 min.
Rainfall intensity =     2.744(In/Hr)
Area averaged loss rate (Fm) =    0.2168(In/Hr)
Area averaged Pervious ratio (Ap) = 0.5000
Summary of stream data:

Stream Flow rate    Area     TC      Fm       Rainfall Intensity
 No.     (CFS)    (Ac.)        (min)  (In/Hr)      (In/Hr)


1     21.66     7.566     10.62    0.210      3.391
2     16.15     7.100     15.12    0.217      2.744
Qmax(1) =
         1.000 *    1.000 *    21.655) +
         1.256 *    0.703 *    16.149) + =      35.909
Qmax(2) =
         0.797 *    1.000 *    21.655) +
         1.000 *    1.000 *    16.149) + =      33.401

Total of 2 streams to confluence:
Flow rates before confluence point:
      21.655      16.149
Maximum flow rates at confluence using above data:
       35.909       33.401
Area of streams before confluence:
        7.566        7.100
Effective area values after confluence:
       12.555       14.666
Results of confluence:
Total flow rate =     35.909(CFS)
Time of concentration =    10.624 min.
Effective stream area after confluence =     12.555(Ac.)
Study area average Pervious fraction(Ap) =  0.500
Study area average soil loss rate(Fm) =    0.213(In/Hr)
Study area total (this main stream) =      14.67(Ac.)


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Process from Point/Station        9.000 to Point/Station       10.000
**** PIPEFLOW TRAVEL TIME (Program estimated size) ****
------------------------------------------------------------------------------
Upstream point/station elevation =  1013.200(Ft.)
Downstream point/station elevation =  1005.000(Ft.)
Pipe length  =   110.00(Ft.)   Manning's N = 0.013
No. of pipes = 1  Required pipe flow  =    35.909(CFS)
Nearest computed pipe diameter  =     21.00(In.)
Calculated individual pipe flow  =    35.909(CFS)
Normal flow depth in pipe =   14.60(In.)
Flow top width inside pipe =   19.33(In.)
Critical depth could not be calculated.
Pipe flow velocity =     20.11(Ft/s)
Travel time through pipe =    0.09 min.
```

```
Time of concentration (TC) =    10.72 min.


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Process from Point/Station       10.000 to Point/Station       10.000
**** SUBAREA FLOW ADDITION ****
------------------------------------------------------------------------------
UNDEVELOPED (poor cover) subarea
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 1.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.000
SCS curve number for soil(AMC 2)  = 78.00
Adjusted SCS curve number for AMC 3 = 92.80
Pervious ratio(Ap) = 1.0000     Max loss rate(Fm)=     0.140(In/Hr)
Time of concentration =    10.72 min.
Rainfall intensity =      3.373(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for area,(total area with modified
rational method)(Q=KCIA) is C = 0.844
Subarea runoff =      1.253(CFS) for    0.500(Ac.)
Total runoff =     37.162(CFS)
Effective area this stream =       13.06(Ac.)
Total Study Area (Main Stream No. 1) =       15.70(Ac.)
Area averaged Fm value =    0.211(In/Hr)


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Process from Point/Station       10.000 to Point/Station       10.000
**** CONFLUENCE OF MINOR STREAMS ****
------------------------------------------------------------------------------
Along Main Stream number: 1 in normal stream number 1
Stream flow area =     13.055(Ac.)
Runoff from this stream =     37.162(CFS)
Time of concentration =   10.72 min.
Rainfall intensity =     3.373(In/Hr)
Area averaged loss rate (Fm) =    0.2107(In/Hr)
Area averaged Pervious ratio (Ap) = 0.5191


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       20.000 to Point/Station       21.000
**** INITIAL AREA EVALUATION ****
------------------------------------------------------------------------------
UNDEVELOPED (poor cover) subarea
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 1.000
Decimal fraction soil group D = 0.000
SCS curve number for soil(AMC 2)  = 86.00
Adjusted SCS curve number for AMC 3 = 97.20
Pervious ratio(Ap) = 1.0000     Max loss rate(Fm)=     0.055(In/Hr)
Initial subarea data:
Initial area flow distance =  1000.000(Ft.)
Top (of initial area) elevation =  1382.000(Ft.)
```

```
Bottom (of initial area) elevation =  1072.400(Ft.)
Difference in elevation =   309.600(Ft.)
Slope =    0.30960  s(%)=      30.96
TC = k(0.525)*[(length^3)/(elevation change)]^0.2
Initial area time of concentration =   10.520 min.
Rainfall intensity =      3.411(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.885
Subarea runoff =     28.690(CFS)
Total initial stream area =        9.500(Ac.)
Pervious area fraction = 1.000
Initial area Fm value =    0.055(In/Hr)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       21.000 to Point/Station       22.000
**** IMPROVED CHANNEL TRAVEL TIME ****
------------------------------------------------------------------------
Upstream point elevation =  1073.200(Ft.)
Downstream point elevation =  1021.000(Ft.)
Channel length thru subarea  =   895.000(Ft.)
Channel base width     =    2.000(Ft.)
Slope or 'Z' of left channel bank =   1.000
Slope or 'Z' of right channel bank =   1.000
Estimated mean flow rate at midpoint of channel =     32.831(CFS)
Manning's 'N'    = 0.015
Maximum depth of channel  =    3.000(Ft.)
Flow(q) thru subarea =     32.831(CFS)
Depth of flow =   0.773(Ft.), Average velocity =  15.314(Ft/s)
Channel flow top width =    3.546(Ft.)
Flow Velocity =   15.31(Ft/s)
Travel time  =    0.97 min.
Time of concentration =   11.49 min.
Critical depth =      1.563(Ft.)
 Adding area flow to channel
UNDEVELOPED (poor cover) subarea
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.020
Decimal fraction soil group C = 0.980
Decimal fraction soil group D = 0.000
SCS curve number for soil(AMC 2)  = 85.84
Adjusted SCS curve number for AMC 3 = 97.17
Pervious ratio(Ap) = 1.0000     Max loss rate(Fm)=     0.056(In/Hr)
Rainfall intensity =      3.234(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for area,(total area with modified
rational method)(Q=KCIA) is C = 0.885
Subarea runoff =      8.217(CFS) for    3.400(Ac.)
Total runoff =     36.907(CFS)
Effective area this stream =       12.90(Ac.)
Total Study Area (Main Stream No. 1) =       28.60(Ac.)
Area averaged Fm value =    0.056(In/Hr)
Depth of flow =   0.825(Ft.), Average velocity =  15.826(Ft/s)
Critical depth =      1.656(Ft.)
```

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++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       22.000 to Point/Station       23.000
**** IMPROVED CHANNEL TRAVEL TIME ****

------------------------------------------------------------------------------
Upstream point elevation =  1021.000(Ft.)
Downstream point elevation =  1018.000(Ft.)
Channel length thru subarea  =   195.000(Ft.)
Channel base width     =    2.000(Ft.)
Slope or 'Z' of left channel bank =   1.000
Slope or 'Z' of right channel bank =   1.000
Estimated mean flow rate at midpoint of channel =     37.292(CFS)
Manning's 'N'    = 0.015
Maximum depth of channel  =    3.000(Ft.)
Flow(q) thru subarea =     37.292(CFS)
Depth of flow =   1.194(Ft.), Average velocity =   9.774(Ft/s)
Channel flow top width =    4.389(Ft.)
Flow Velocity =    9.77(Ft/s)
Travel time  =    0.33 min.
Time of concentration =   11.83 min.
Critical depth =      1.672(Ft.)
 Adding area flow to channel
UNDEVELOPED (average cover) subarea
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 1.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.000
SCS curve number for soil(AMC 2)  = 69.00
Adjusted SCS curve number for AMC 3 = 86.20
Pervious ratio(Ap) = 1.0000     Max loss rate(Fm)=     0.262(In/Hr)
Rainfall intensity =      3.180(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for area,(total area with modified
rational method)(Q=KCIA) is C = 0.882
Subarea runoff =      0.676(CFS) for    0.500(Ac.)
Total runoff =     37.583(CFS)
Effective area this stream =       13.40(Ac.)
Total Study Area (Main Stream No. 1) =       29.10(Ac.)
Area averaged Fm value =    0.063(In/Hr)
Depth of flow =   1.199(Ft.), Average velocity =   9.794(Ft/s)
Critical depth =      1.672(Ft.)


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Process from Point/Station       24.000 to Point/Station       23.000
**** SUBAREA FLOW ADDITION ****

------------------------------------------------------------------------------
UNDEVELOPED (poor cover) subarea
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.700
Decimal fraction soil group C = 0.300
Decimal fraction soil group D = 0.000
SCS curve number for soil(AMC 2)  = 80.40
Adjusted SCS curve number for AMC 3 = 94.24
Pervious ratio(Ap) = 1.0000     Max loss rate(Fm)=     0.113(In/Hr)
Time of concentration =    11.83 min.
```

```
Rainfall intensity =      3.180(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for area,(total area with modified
rational method)(Q=KCIA) is C = 0.881
Subarea runoff =      1.932(CFS) for    0.700(Ac.)
Total runoff =     39.515(CFS)
Effective area this stream =       14.10(Ac.)
Total Study Area (Main Stream No. 1) =       29.80(Ac.)
Area averaged Fm value =    0.066(In/Hr)


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Process from Point/Station       23.000 to Point/Station       10.000
**** STREET FLOW TRAVEL TIME + SUBAREA FLOW ADDITION ****
------------------------------------------------------------------------------
Top of street segment elevation =  1018.000(Ft.)
End of street segment elevation =  1004.000(Ft.)
Length of street segment  =   595.000(Ft.)
Height of curb above gutter flowline  =    6.0(In.)
Width of half street (curb to crown)  =  17.000(Ft.)
Distance from crown to crossfall grade break  =   7.000(Ft.)
Slope from gutter to grade break (v/hz) =   0.020
Slope from grade break to crown (v/hz)  =   0.020
Street flow is on [1] side(s) of the street
Distance from curb to property line  =   7.000(Ft.)
Slope from curb to property line (v/hz) =   0.020
Gutter width =   2.000(Ft.)
Gutter hike from flowline =  2.000(In.)
 Manning's N in gutter =  0.0150
 Manning's N from gutter to grade break =  0.0150
 Manning's N from grade break to crown =  0.0150
Estimated mean flow rate at midpoint of street =     39.541(CFS)
Depth of flow =   0.636(Ft.), Average velocity =   6.216(Ft/s)
Warning: depth of flow exceeds top of curb
Note:  depth of flow exceeds top of street crown.
Distance that curb overflow reaches into property =    6.81(Ft.)
Streetflow hydraulics at midpoint of street travel:
Halfstreet flow width =  17.000(Ft.)
Flow velocity =   6.22(Ft/s)
Travel time =    1.60 min.     TC =   13.42  min.
 Adding area flow to street
COMMERCIAL subarea type
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 1.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.000
SCS curve number for soil(AMC 2)  = 56.00
Adjusted SCS curve number for AMC 3 = 75.80
Pervious ratio(Ap) = 0.1000     Max loss rate(Fm)=     0.044(In/Hr)
The area added to the existing stream causes a
a lower flow rate of Q =     38.132(CFS)
therefore the upstream flow rate of Q =     39.515(CFS) is being used
Rainfall intensity =      2.947(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for area,(total area with modified
rational method)(Q=KCIA) is C = 0.880
```

```
Subarea runoff =      0.000(CFS) for    0.600(Ac.)
Total runoff =     39.515(CFS)
Effective area this stream =       14.70(Ac.)
Total Study Area (Main Stream No. 1) =       30.40(Ac.)
Area averaged Fm value =    0.065(In/Hr)
Street flow at end of street =     39.515(CFS)
Half street flow at end of street =     39.515(CFS)
Depth of flow =   0.636(Ft.), Average velocity =   6.215(Ft/s)
Warning: depth of flow exceeds top of curb
Note:  depth of flow exceeds top of street crown.
Distance that curb overflow reaches into property =    6.80(Ft.)
Flow width (from curb towards crown)=  17.000(Ft.)


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Process from Point/Station       10.000 to Point/Station       10.000
**** CONFLUENCE OF MINOR STREAMS ****
------------------------------------------------------------------------------
Along Main Stream number: 1 in normal stream number 2
Stream flow area =     14.700(Ac.)
Runoff from this stream =     39.515(CFS)
Time of concentration =   13.42 min.
Rainfall intensity =     2.947(In/Hr)
Area averaged loss rate (Fm) =    0.0648(In/Hr)
Area averaged Pervious ratio (Ap) = 0.9633


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Process from Point/Station       30.000 to Point/Station       31.000
**** INITIAL AREA EVALUATION ****
------------------------------------------------------------------------------
UNDEVELOPED (poor cover) subarea
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.050
Decimal fraction soil group C = 0.950
Decimal fraction soil group D = 0.000
SCS curve number for soil(AMC 2)  = 85.60
Adjusted SCS curve number for AMC 3 = 97.12
Pervious ratio(Ap) = 1.0000     Max loss rate(Fm)=     0.057(In/Hr)
Initial subarea data:
Initial area flow distance =  1000.000(Ft.)
Top (of initial area) elevation =  1248.000(Ft.)
Bottom (of initial area) elevation =  1080.000(Ft.)
Difference in elevation =   168.000(Ft.)
Slope =    0.16800  s(%)=      16.80
TC = k(0.525)*[(length^3)/(elevation change)]^0.2
Initial area time of concentration =   11.888 min.
Rainfall intensity =      3.170(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.884
Subarea runoff =     13.447(CFS)
Total initial stream area =        4.800(Ac.)
Pervious area fraction = 1.000
Initial area Fm value =    0.057(In/Hr)
```

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Process from Point/Station       31.000 to Point/Station       32.000
**** IMPROVED CHANNEL TRAVEL TIME ****

------------------------------------------------------------------------------
Upstream point elevation =  1080.000(Ft.)
Downstream point elevation =  1072.200(Ft.)
Channel length thru subarea  =   520.000(Ft.)
Channel base width     =    0.000(Ft.)
Slope or 'Z' of left channel bank =   1.000
Slope or 'Z' of right channel bank =   1.000
Estimated mean flow rate at midpoint of channel =     18.989(CFS)
Manning's 'N'    = 0.015
Maximum depth of channel  =    2.000(Ft.)
Flow(q) thru subarea =     18.989(CFS)
Depth of flow =   1.534(Ft.), Average velocity =   8.069(Ft/s)
Channel flow top width =    3.068(Ft.)
Flow Velocity =    8.07(Ft/s)
Travel time  =    1.07 min.
Time of concentration =   12.96 min.
Critical depth =      1.859(Ft.)
 Adding area flow to channel
UNDEVELOPED (poor cover) subarea
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.050
Decimal fraction soil group C = 0.950
Decimal fraction soil group D = 0.000
SCS curve number for soil(AMC 2)  = 85.60
Adjusted SCS curve number for AMC 3 = 97.12
Pervious ratio(Ap) = 1.0000     Max loss rate(Fm)=     0.057(In/Hr)
Rainfall intensity =      3.009(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for area,(total area with modified
rational method)(Q=KCIA) is C = 0.883
Subarea runoff =     10.999(CFS) for    4.400(Ac.)
Total runoff =     24.446(CFS)
Effective area this stream =        9.20(Ac.)
Total Study Area (Main Stream No. 1) =       39.60(Ac.)
Area averaged Fm value =    0.057(In/Hr)
Depth of flow =   1.686(Ft.), Average velocity =   8.595(Ft/s)
Critical depth =      2.047(Ft.)


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Process from Point/Station       32.000 to Point/Station       10.000
**** STREET FLOW TRAVEL TIME + SUBAREA FLOW ADDITION ****

------------------------------------------------------------------------------
Top of street segment elevation =  1072.700(Ft.)
End of street segment elevation =  1004.000(Ft.)
Length of street segment  =   790.000(Ft.)
Height of curb above gutter flowline  =    6.0(In.)
Width of half street (curb to crown)  =  18.000(Ft.)
Distance from crown to crossfall grade break  =   7.000(Ft.)
Slope from gutter to grade break (v/hz) =   0.020
Slope from grade break to crown (v/hz)  =   0.020
```

```
Street flow is on [1] side(s) of the street
Distance from curb to property line  =   7.000(Ft.)
Slope from curb to property line (v/hz) =   0.020
Gutter width =   2.000(Ft.)
Gutter hike from flowline =  2.000(In.)
 Manning's N in gutter =  0.0150
 Manning's N from gutter to grade break =  0.0150
 Manning's N from grade break to crown =  0.0150
Estimated mean flow rate at midpoint of street =     24.496(CFS)
Depth of flow =   0.452(Ft.), Average velocity =   8.820(Ft/s)
Streetflow hydraulics at midpoint of street travel:
Halfstreet flow width =  16.281(Ft.)
Flow velocity =   8.82(Ft/s)
Travel time =    1.49 min.     TC =   14.45  min.
 Adding area flow to street
COMMERCIAL subarea type
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 1.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.000
SCS curve number for soil(AMC 2)  = 56.00
Adjusted SCS curve number for AMC 3 = 75.80
Pervious ratio(Ap) = 0.1000     Max loss rate(Fm)=     0.044(In/Hr)
The area added to the existing stream causes a
a lower flow rate of Q =     24.367(CFS)
therefore the upstream flow rate of Q =     24.446(CFS) is being used
Rainfall intensity =      2.819(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for area,(total area with modified
rational method)(Q=KCIA) is C = 0.882
Subarea runoff =      0.000(CFS) for    0.600(Ac.)
Total runoff =     24.446(CFS)
Effective area this stream =        9.80(Ac.)
Total Study Area (Main Stream No. 1) =       40.20(Ac.)
Area averaged Fm value =    0.056(In/Hr)
Street flow at end of street =     24.446(CFS)
Half street flow at end of street =     24.446(CFS)
Depth of flow =   0.452(Ft.), Average velocity =   8.815(Ft/s)
Flow width (from curb towards crown)=  16.268(Ft.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       10.000 to Point/Station       10.000
**** CONFLUENCE OF MINOR STREAMS ****
------------------------------------------------------------------------------
Along Main Stream number: 1 in normal stream number 3
Stream flow area =      9.800(Ac.)
Runoff from this stream =     24.446(CFS)
Time of concentration =   14.45 min.
Rainfall intensity =     2.819(In/Hr)
Area averaged loss rate (Fm) =    0.0562(In/Hr)
Area averaged Pervious ratio (Ap) = 0.9449
Summary of stream data:

Stream Flow rate    Area    TC     Fm       Rainfall Intensity
```

```
 No.     (CFS)    (Ac.)        (min)  (In/Hr)      (In/Hr)


1      37.16    13.055      10.72     0.211       3.373
2      39.51    14.700      13.42     0.065       2.947
3      24.45     9.800      14.45     0.056       2.819
Qmax(1) =
          1.000 *    1.000 *    37.162) +
          1.148 *    0.798 *    39.515) +
          1.201 *    0.741 *    24.446) + =       95.134
Qmax(2) =
          0.865 *    1.000 *    37.162) +
          1.000 *    1.000 *    39.515) +
          1.046 *    0.929 *    24.446) + =       95.419
Qmax(3) =
          0.825 *    1.000 *    37.162) +
          0.956 *    1.000 *    39.515) +
          1.000 *    1.000 *    24.446) + =       92.848

Total of 3 streams to confluence:
Flow rates before confluence point:
      37.162      39.515      24.446
Maximum flow rates at confluence using above data:
       95.134       95.419       92.848
Area of streams before confluence:
       13.055       14.700        9.800
Effective area values after confluence:
       32.055       36.855       37.555
Results of confluence:
Total flow rate =     95.419(CFS)
Time of concentration =    13.422 min.
Effective stream area after confluence =     36.855(Ac.)
Study area average Pervious fraction(Ap) =  0.804
Study area average soil loss rate(Fm) =    0.113(In/Hr)
Study area total (this main stream) =      37.56(Ac.)
End of computations, Total Study Area =           40.20 (Ac.)
The following figures may
be used for a unit hydrograph study of the same area.
Note: These figures do not consider reduced effective area
effects caused by confluences in the rational equation.

Area averaged pervious area fraction(Ap) = 0.784
Area averaged SCS curve number =  73.6
```

San Bernardino County Rational Hydrology Program

(Hydrology Manual Date - August 1986)

CIVILCADD/CIVILDESIGN Engineering Software, (c) 1989-2005 Version 7.1
Rational Hydrology Study Date: 09/26/16

Tr 18233
100-Year Hydrology Study
Developed Condition Area "B"

Program License Serial Number 6194

********* Hydrology Study Control Information **********

Rational hydrology study storm event year is 100.0
Computed rainfall intensity:
Storm year = 100.00 1 hour rainfall = 1.200 (In.)
Slope used for rainfall intensity curve b = 0.6000
Soil antecedent moisture condition (AMC) = 3

++
Process from Point/Station 40.000 to Point/Station 42.000
**** INITIAL AREA EVALUATION ****

RESIDENTIAL(1 acre lot)
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.200
Decimal fraction soil group C = 0.800
Decimal fraction soil group D = 0.000
SCS curve number for soil(AMC 2) = 66.40
Adjusted SCS curve number for AMC 3 = 84.12
Pervious ratio(Ap) = 0.8000 Max loss rate(Fm)= 0.239(In/Hr)
Initial subarea data:
Initial area flow distance = 610.000(Ft.)
Top (of initial area) elevation = 1134.000(Ft.)
Bottom (of initial area) elevation = 1030.000(Ft.)
Difference in elevation = 104.000(Ft.)
Slope = 0.17049 s(%)= 17.05
TC = k(0.469)*[(length^3)/(elevation change)]^0.2
Initial area time of concentration = 8.689 min.
Rainfall intensity = 3.826(In/Hr) for a 100.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.844
Subarea runoff = 8.393(CFS)
Total initial stream area = 2.600(Ac.)
Pervious area fraction = 0.800
Initial area Fm value = 0.239(In/Hr)

```
++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       42.000 to Point/Station       42.000
**** CONFLUENCE OF MINOR STREAMS ****
------------------------------------------------------------------------------
Along Main Stream number: 1 in normal stream number 1
Stream flow area =      2.600(Ac.)
Runoff from this stream =      8.393(CFS)
Time of concentration =    8.69 min.
Rainfall intensity =     3.826(In/Hr)
Area averaged loss rate (Fm) =    0.2388(In/Hr)
Area averaged Pervious ratio (Ap) = 0.8000


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       41.000 to Point/Station       42.000
**** INITIAL AREA EVALUATION ****
------------------------------------------------------------------------------
UNDEVELOPED (poor cover) subarea
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 1.000
Decimal fraction soil group D = 0.000
SCS curve number for soil(AMC 2)  = 86.00
Adjusted SCS curve number for AMC 3 = 97.20
Pervious ratio(Ap) = 1.0000     Max loss rate(Fm)=     0.055(In/Hr)
Initial subarea data:
Initial area flow distance =   500.000(Ft.)
Top (of initial area) elevation =  1134.000(Ft.)
Bottom (of initial area) elevation =  1030.000(Ft.)
Difference in elevation =   104.000(Ft.)
Slope =    0.20800  s(%)=      20.80
TC = k(0.525)*[(length^3)/(elevation change)]^0.2
Initial area time of concentration =    8.632 min.
Rainfall intensity =      3.841(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.887
Subarea runoff =      5.110(CFS)
Total initial stream area =        1.500(Ac.)
Pervious area fraction = 1.000
Initial area Fm value =    0.055(In/Hr)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       42.000 to Point/Station       42.000
**** CONFLUENCE OF MINOR STREAMS ****
------------------------------------------------------------------------------
Along Main Stream number: 1 in normal stream number 2
Stream flow area =      1.500(Ac.)
Runoff from this stream =      5.110(CFS)
Time of concentration =    8.63 min.
Rainfall intensity =     3.841(In/Hr)
Area averaged loss rate (Fm) =    0.0554(In/Hr)
Area averaged Pervious ratio (Ap) = 1.0000
```

```
Summary of stream data:

Stream Flow rate    Area     TC      Fm       Rainfall Intensity
 No.     (CFS)    (Ac.)      (min)  (In/Hr)      (In/Hr)


1       8.39      2.600       8.69    0.239       3.826
2       5.11      1.500       8.63    0.055       3.841
Qmax(1) =
          1.000 *     1.000 *      8.393) +
          0.996 *     1.000 *      5.110) + =       13.483
Qmax(2) =
          1.004 *     0.994 *      8.393) +
          1.000 *     1.000 *      5.110) + =       13.483

Total of 2 streams to confluence:
Flow rates before confluence point:
        8.393        5.110
Maximum flow rates at confluence using above data:
       13.483       13.483
Area of streams before confluence:
         2.600        1.500
Effective area values after confluence:
         4.100        4.083
Results of confluence:
Total flow rate =      13.483(CFS)
Time of concentration =      8.632 min.
Effective stream area after confluence =       4.083(Ac.)
Study area average Pervious fraction(Ap) =  0.873
Study area average soil loss rate(Fm) =    0.172(In/Hr)
Study area total (this main stream) =       4.10(Ac.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       42.000 to Point/Station       47.000
**** STREET FLOW TRAVEL TIME + SUBAREA FLOW ADDITION ****
------------------------------------------------------------------------------
Top of street segment elevation =  1030.000(Ft.)
End of street segment elevation =  1009.000(Ft.)
Length of street segment  =   270.000(Ft.)
Height of curb above gutter flowline  =    6.0(In.)
Width of half street (curb to crown)  =  18.000(Ft.)
Distance from crown to crossfall grade break  =  10.000(Ft.)
Slope from gutter to grade break (v/hz) =   0.020
Slope from grade break to crown (v/hz)  =   0.020
Street flow is on [1] side(s) of the street
Distance from curb to property line  =   7.000(Ft.)
Slope from curb to property line (v/hz) =   0.020
Gutter width =   2.000(Ft.)
Gutter hike from flowline =  2.000(In.)
 Manning's N in gutter =  0.0150
 Manning's N from gutter to grade break =  0.0150
 Manning's N from grade break to crown =  0.0150
Estimated mean flow rate at midpoint of street =     14.662(CFS)
```

```
Depth of flow =   0.398(Ft.), Average velocity =   7.471(Ft/s)
Streetflow hydraulics at midpoint of street travel:
Halfstreet flow width =  13.549(Ft.)
Flow velocity =   7.47(Ft/s)
Travel time =    0.60 min.     TC =    9.23  min.
 Adding area flow to street
RESIDENTIAL(3 - 4 dwl/acre)
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.350
Decimal fraction soil group C = 0.650
Decimal fraction soil group D = 0.000
SCS curve number for soil(AMC 2)  = 64.45
Adjusted SCS curve number for AMC 3 = 82.56
Pervious ratio(Ap) = 0.6000     Max loss rate(Fm)=     0.195(In/Hr)
Rainfall intensity =      3.688(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for area,(total area with modified
rational method)(Q=KCIA) is C = 0.857
Subarea runoff =      2.268(CFS) for    0.900(Ac.)
Total runoff =     15.752(CFS)
Effective area this stream =        4.98(Ac.)
Total Study Area (Main Stream No. 1) =        5.00(Ac.)
Area averaged Fm value =    0.176(In/Hr)
Street flow at end of street =     15.752(CFS)
Half street flow at end of street =     15.752(CFS)
Depth of flow =   0.406(Ft.), Average velocity =   7.600(Ft/s)
Flow width (from curb towards crown)=  13.949(Ft.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       47.000 to Point/Station       47.000
**** CONFLUENCE OF MAIN STREAMS ****
------------------------------------------------------------------------
The following data inside Main Stream is listed:
In Main Stream number: 1
Stream flow area =      4.983(Ac.)
Runoff from this stream =     15.752(CFS)
Time of concentration =    9.23 min.
Rainfall intensity =     3.688(In/Hr)
Area averaged loss rate (Fm) =    0.1760(In/Hr)
Area averaged Pervious ratio (Ap) = 0.8238
Program is now starting with Main Stream No. 2


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       43.000 to Point/Station       44.000
**** INITIAL AREA EVALUATION ****
------------------------------------------------------------------------
UNDEVELOPED (poor cover) subarea
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 1.000
Decimal fraction soil group D = 0.000
SCS curve number for soil(AMC 2)  = 86.00
Adjusted SCS curve number for AMC 3 = 97.20
```

```
Pervious ratio(Ap) = 1.0000     Max loss rate(Fm)=     0.055(In/Hr)
Initial subarea data:
Initial area flow distance =   370.000(Ft.)
Top (of initial area) elevation =  1132.000(Ft.)
Bottom (of initial area) elevation =  1032.000(Ft.)
Difference in elevation =   100.000(Ft.)
Slope =    0.27027  s(%)=      27.03
TC = k(0.525)*[(length^3)/(elevation change)]^0.2
Initial area time of concentration =    7.262 min.
Rainfall intensity =      4.260(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.888
Subarea runoff =      4.163(CFS)
Total initial stream area =        1.100(Ac.)
Pervious area fraction = 1.000
Initial area Fm value =    0.055(In/Hr)


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Process from Point/Station       44.000 to Point/Station       46.000
**** IMPROVED CHANNEL TRAVEL TIME ****
------------------------------------------------------------------------------
Upstream point elevation =  1032.000(Ft.)
Downstream point elevation =  1030.000(Ft.)
Channel length thru subarea  =   160.000(Ft.)
Channel base width     =    0.000(Ft.)
Slope or 'Z' of left channel bank =   1.000
Slope or 'Z' of right channel bank =   1.000
Estimated mean flow rate at midpoint of channel =      8.319(CFS)
Manning's 'N'    = 0.015
Maximum depth of channel  =    2.000(Ft.)
Flow(q) thru subarea =      8.319(CFS)
Depth of flow =   1.165(Ft.), Average velocity =   6.131(Ft/s)
Channel flow top width =    2.330(Ft.)
Flow Velocity =    6.13(Ft/s)
Travel time  =    0.43 min.
Time of concentration =    7.70 min.
Critical depth =      1.344(Ft.)
 Adding area flow to channel
UNDEVELOPED (poor cover) subarea
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 1.000
Decimal fraction soil group D = 0.000
SCS curve number for soil(AMC 2)  = 86.00
Adjusted SCS curve number for AMC 3 = 97.20
Pervious ratio(Ap) = 1.0000     Max loss rate(Fm)=     0.055(In/Hr)
Rainfall intensity =      4.114(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for area,(total area with modified
rational method)(Q=KCIA) is C = 0.888
Subarea runoff =      8.257(CFS) for    2.300(Ac.)
Total runoff =     12.419(CFS)
Effective area this stream =        3.40(Ac.)
Total Study Area (Main Stream No. 2) =        8.40(Ac.)
Area averaged Fm value =    0.055(In/Hr)
```

```
Depth of flow =   1.354(Ft.), Average velocity =   6.777(Ft/s)
Critical depth =      1.570(Ft.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       46.000 to Point/Station       46.000
**** CONFLUENCE OF MINOR STREAMS ****
------------------------------------------------------------------------
Along Main Stream number: 2 in normal stream number 1
Stream flow area =      3.400(Ac.)
Runoff from this stream =     12.419(CFS)
Time of concentration =    7.70 min.
Rainfall intensity =     4.114(In/Hr)
Area averaged loss rate (Fm) =    0.0554(In/Hr)
Area averaged Pervious ratio (Ap) = 1.0000


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       45.000 to Point/Station       46.000
**** INITIAL AREA EVALUATION ****
------------------------------------------------------------------------
UNDEVELOPED (poor cover) subarea
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 1.000
Decimal fraction soil group D = 0.000
SCS curve number for soil(AMC 2)  = 86.00
Adjusted SCS curve number for AMC 3 = 97.20
Pervious ratio(Ap) = 1.0000     Max loss rate(Fm)=     0.055(In/Hr)
Initial subarea data:
Initial area flow distance =   560.000(Ft.)
Top (of initial area) elevation =  1250.000(Ft.)
Bottom (of initial area) elevation =  1032.000(Ft.)
Difference in elevation =   218.000(Ft.)
Slope =    0.38929  s(%)=      38.93
TC = k(0.525)*[(length^3)/(elevation change)]^0.2
Initial area time of concentration =    7.969 min.
Rainfall intensity =      4.029(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.888
Subarea runoff =      3.219(CFS)
Total initial stream area =        0.900(Ac.)
Pervious area fraction = 1.000
Initial area Fm value =    0.055(In/Hr)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       46.000 to Point/Station       46.000
**** CONFLUENCE OF MINOR STREAMS ****
------------------------------------------------------------------------
Along Main Stream number: 2 in normal stream number 2
Stream flow area =      0.900(Ac.)
Runoff from this stream =      3.219(CFS)
Time of concentration =    7.97 min.
Rainfall intensity =     4.029(In/Hr)
```

```
Area averaged loss rate (Fm) =    0.0554(In/Hr)
Area averaged Pervious ratio (Ap) = 1.0000
Summary of stream data:

Stream Flow rate    Area     TC      Fm       Rainfall Intensity
 No.     (CFS)    (Ac.)      (min)  (In/Hr)      (In/Hr)


1     12.42      3.400       7.70    0.055       4.114
2      3.22      0.900       7.97    0.055       4.029
Qmax(1) =
         1.000 *    1.000 *    12.419) +
         1.021 *    0.966 *     3.219) + =      15.595
Qmax(2) =
         0.979 *    1.000 *    12.419) +
         1.000 *    1.000 *     3.219) + =      15.380

Total of 2 streams to confluence:
Flow rates before confluence point:
      12.419       3.219
Maximum flow rates at confluence using above data:
       15.595       15.380
Area of streams before confluence:
        3.400        0.900
Effective area values after confluence:
        4.269        4.300
Results of confluence:
Total flow rate =     15.595(CFS)
Time of concentration =     7.697 min.
Effective stream area after confluence =      4.269(Ac.)
Study area average Pervious fraction(Ap) =  1.000
Study area average soil loss rate(Fm) =    0.055(In/Hr)
Study area total (this main stream) =       4.30(Ac.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       46.000 to Point/Station       47.000
**** STREET FLOW TRAVEL TIME + SUBAREA FLOW ADDITION ****
------------------------------------------------------------------------------
Top of street segment elevation =  1030.000(Ft.)
End of street segment elevation =  1009.000(Ft.)
Length of street segment  =   200.000(Ft.)
Height of curb above gutter flowline  =    6.0(In.)
Width of half street (curb to crown)  =  18.000(Ft.)
Distance from crown to crossfall grade break  =  10.000(Ft.)
Slope from gutter to grade break (v/hz) =   0.020
Slope from grade break to crown (v/hz)  =   0.020
Street flow is on [1] side(s) of the street
Distance from curb to property line  =   7.000(Ft.)
Slope from curb to property line (v/hz) =   0.020
Gutter width =   2.000(Ft.)
Gutter hike from flowline =  2.000(In.)
 Manning's N in gutter =  0.0150
 Manning's N from gutter to grade break =  0.0150
```

```
 Manning's N from grade break to crown =  0.0150
Estimated mean flow rate at midpoint of street =     16.610(CFS)
Depth of flow =   0.395(Ft.), Average velocity =   8.628(Ft/s)
Streetflow hydraulics at midpoint of street travel:
Halfstreet flow width =  13.410(Ft.)
Flow velocity =   8.63(Ft/s)
Travel time =    0.39 min.     TC =    8.08  min.
 Adding area flow to street
RESIDENTIAL(3 - 4 dwl/acre)
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.100
Decimal fraction soil group C = 0.900
Decimal fraction soil group D = 0.000
SCS curve number for soil(AMC 2)  = 67.70
Adjusted SCS curve number for AMC 3 = 85.16
Pervious ratio(Ap) = 0.6000     Max loss rate(Fm)=     0.168(In/Hr)
Rainfall intensity =      3.995(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for area,(total area with modified
rational method)(Q=KCIA) is C = 0.884
Subarea runoff =      1.953(CFS) for    0.700(Ac.)
Total runoff =     17.548(CFS)
Effective area this stream =        4.97(Ac.)
Total Study Area (Main Stream No. 2) =       10.00(Ac.)
Area averaged Fm value =    0.071(In/Hr)
Street flow at end of street =     17.548(CFS)
Half street flow at end of street =     17.548(CFS)
Depth of flow =   0.401(Ft.), Average velocity =   8.742(Ft/s)
Flow width (from curb towards crown)=  13.713(Ft.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       47.000 to Point/Station       47.000
**** CONFLUENCE OF MAIN STREAMS ****
------------------------------------------------------------------------
The following data inside Main Stream is listed:
In Main Stream number: 2
Stream flow area =      4.969(Ac.)
Runoff from this stream =     17.548(CFS)
Time of concentration =    8.08 min.
Rainfall intensity =     3.995(In/Hr)
Area averaged loss rate (Fm) =    0.0713(In/Hr)
Area averaged Pervious ratio (Ap) = 0.9437
Summary of stream data:

Stream Flow rate    Area     TC      Fm       Rainfall Intensity
 No.     (CFS)    (Ac.)       (min) (In/Hr)      (In/Hr)


1      15.75      4.983       9.23     0.176       3.688
2      17.55      4.969       8.08     0.071       3.995
Qmax(1) =
         1.000 *     1.000 *     15.752) +
         0.922 *     1.000 *     17.548) + =      31.928
Qmax(2) =
```

```
        1.087 *    0.875 *    15.752) +
        1.000 *    1.000 *    17.548) + =      32.540

Total of 2 main streams to confluence:
Flow rates before confluence point:
     16.752      18.548
Maximum flow rates at confluence using above data:
      31.928       32.540
Area of streams before confluence:
       4.983        4.969
Effective area values after confluence:
       9.952        9.331


Results of confluence:
Total flow rate =     32.540(CFS)
Time of concentration =     8.084 min.
Effective stream area after confluence  =      9.331(Ac.)
Study area average Pervious fraction(Ap) =  0.884
Study area average soil loss rate(Fm) =    0.124(In/Hr)
Study area total =       9.95(Ac.)
End of computations, Total Study Area =           10.00 (Ac.)
The following figures may
be used for a unit hydrograph study of the same area.
Note: These figures do not consider reduced effective area
effects caused by confluences in the rational equation.

Area averaged pervious area fraction(Ap) = 0.884
Area averaged SCS curve number =  77.7
```

Street Flow Calculation
TTM 18233 Scott Mckhann

Designer: LCJ
Date: 05/09/17 04:09 PM

***** Input Data *****

Pkwy. Slope = 0.0200
Street Slope = 0.0200
Half R/W Width = 30.00'
Half Street Width = 20.00'
Curb Height = 0.50'
Curb Batter = 0.1250'
Gutter Width = 2.00'
Gutter Hike = 0.1560'
Gutter Lip = 0.0313'
N(Road) = 0.015
N(Pkwy) = 0.030

***** Output Data *****

Slope of Curb Face = 4.0000
Slope of Gutter = 0.0832'
Depth at Crown = 0.5473'
Depth at R/W = 0.7000'

Depth	Flood Width	Area	Perim	Q/So^1/2
0.10'	1.23'	0.06	1.31'	0.8
0.11'	1.35'	0.07	1.44'	1.0
0.12'	1.47'	0.09	1.57'	1.3
0.13'	1.60'	0.10	1.70'	1.6
0.14'	1.72'	0.12	1.83'	1.9
0.15'	1.84'	0.14	1.96'	2.3
0.16'	1.92'	0.17	2.05'	3.1
0.17'	1.92'	0.19	2.07'	3.7
0.18'	1.92'	0.21	2.09'	4.4
0.19'	2.06'	0.23	2.24'	4.9
0.20'	2.56'	0.25	2.75'	5.1
0.21'	3.06'	0.28	3.26'	5.5
0.22'	3.57'	0.32	3.77'	6.0
0.23'	4.07'	0.36	4.29'	6.7
0.24'	4.57'	0.40	4.80'	7.6
0.25'	5.07'	0.45	5.31'	8.6
0.26'	5.58'	0.50	5.82'	9.8
0.27'	6.08'	0.56	6.33'	11.2
0.28'	6.58'	0.63	6.84'	12.7
0.29'	7.08'	0.70	7.35'	14.4
0.30'	7.59'	0.77	7.86'	16.3
0.31'	8.09'	0.85	8.37'	18.4
0.32'	8.59'	0.94	8.88'	20.7
0.33'	9.09'	1.03	9.39'	23.3
0.34'	9.60'	1.12	9.90'	26.0
0.35'	10.10'	1.22	10.41'	29.0
0.36'	10.60'	1.33	10.92'	32.2
0.37'	11.10'	1.44	11.43'	35.7
0.38'	11.61'	1.55	11.94'	39.4
0.39'	12.11'	1.67	12.45'	43.4
0.40'	12.61'	1.80	12.96'	47.6
0.41'	13.11'	1.92	13.47'	52.1
0.42'	13.62'	2.06	13.98'	56.9
0.43'	14.12'	2.20	14.49'	62.0
0.44'	14.62'	2.34	15.00'	67.4
0.45'	15.12'	2.49	15.51'	73.1
0.46'	15.63'	2.65	16.02'	79.1
0.47'	16.13'	2.81	16.54'	85.4
0.48'	16.63'	2.97	17.05'	92.0
0.49'	17.13'	3.14	17.56'	99.0
0.50'	17.64'	3.32	18.07'	106.3
Depth Exceeds Curb				
0.51'	18.64'	3.50	19.07'	114.0
0.52'	19.64'	3.70	20.07'	122.1
0.53'	20.64'	3.90	21.07'	130.6
0.54'	21.64'	4.11	22.07'	139.5
Depth Exceeds Crown				
0.55'	45.00'	8.72	45.86'	301.7

0.56'	46.00'	9.36	46.86'	336.9
0.57'	47.00'	10.01	47.86'	373.7
0.58'	48.00'	10.67	48.87'	412.1
0.59'	49.00'	11.34	49.87'	452.0
0.60'	50.00'	12.01	50.87'	493.6
0.61'	51.00'	12.70	51.87'	536.7
0.62'	52.00'	13.40	52.87'	581.3
0.63'	53.00'	14.11	53.87'	627.5
0.64'	54.00'	14.83	54.87'	675.1
0.65'	55.00'	15.56	55.87'	724.3
0.66'	56.00'	16.30	56.87'	775.0
0.67'	57.00'	17.05	57.87'	827.1
0.68'	58.00'	17.80	58.87'	880.8
0.69'	59.00'	18.57	59.87'	935.9
0.70'	60.00'	19.35	60.87'	992.4

Depth Exceeds Right of Way